PROJECT MANUAL

NORTH READING FIRE STATION RENOVATION

152 Park Street
North Reading, MA 01864

DESIGN DEVELOPMENT
May 7, 2024

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PROJECT MANUAL

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* Filed Sub-Bid Required

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* Filed Sub-Bid Required

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* Filed Sub-Bid Required

DOCUMENT 000117

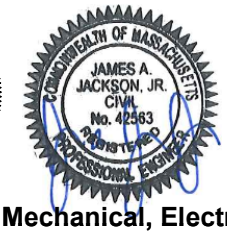
PROJECT DIRECTORY

SPECIFICATIONS FOR
North Reading Fire Station Renovation
152 Park Street
North Reading, MA 01864

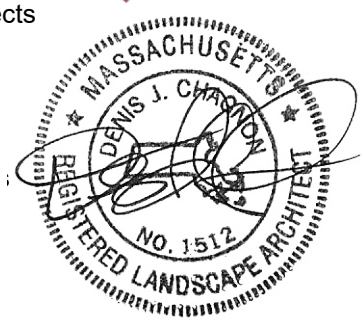
Owner
Town of North Reading
Town Hall
23 North Street
North Reading, MA 01864

Architect
HKT Architects Inc.
24 Roland Street, Suite 301
Charlestown, MA 02129

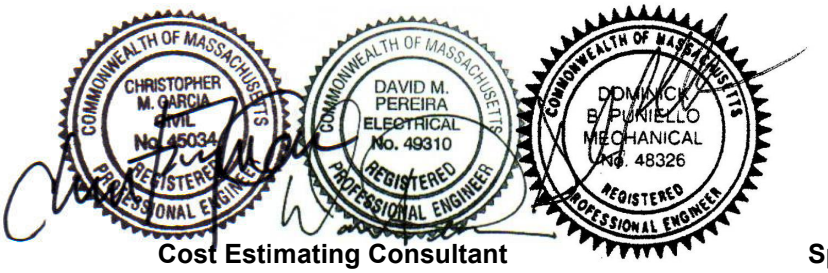
Structural / Civil /Geotechnical Engineers
Pare Corporation
10 Lincoln Road, Suite 210
Foxborough, MA 02035



Landscape Architect
CBA Landscape Architects
24 Thorndike Street
Cambridge, MA 02141



Mechanical, Electrical, Plumbing and Fire Protection Engineers
GGD Consulting Engineers, Inc.
375 Faunce Corner Road, Suite D
Dartmouth, MA 02747



Code Consultant
SLS Consulting, LLC
One Lincoln Street
Boston, MA 02111

Cost Estimating Consultant
Tortora Consulting, Inc.
165 Middlesex Turnpike, Suite 106
Bedford, MA 01730

Specifications Consultant
Kalin Associates
1121 Washington Street, Suite 2
West Newton, MA 02465

END OF DOCUMENT

SECTION 011100

SUMMARY OF WORK

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes the following:

1. Work covered by the Contract Documents
2. Contract Method
3. Contract Conditions
4. Work under other contracts
5. Work Sequence
6. Owner-furnished products
7. Permits, inspection and testing required by Governing Authorities
8. Specification formats and conventions.
9. Reference standards.
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B. Related Sections include the following:

1. Section 013100 – PROJECT MANAGEMENT AND COORDINATION, for field engineering and coordination requirements.
2. Section 013119 – PROJECT MEETINGS, for pre-construction conference and regular site meetings.
3. Section 013200– CONSTRUCTION PROGRESS DOCUMENTATION, for requirements for preparing and submitting progress schedule, including preliminary submittal of sequencing plan.
4. Section 011400 – WORK RESTRICTIONS, for contractor’s use of premises and other contract requirements during construction.
5. Section 015000 – TEMPORARY FACILITIES AND CONTROLS, for additional information on temporary measures required during construction.
6. Section 017400 – CONSTRUCTION WASTE MANAGEMENT, for removal of non-hazardous debris.
7. Section 017329 – CUTTING AND PATCHING, for requirements for cutting and patching.

1.3 WORK UNDER THIS CONTRACT

A. Project Identification:

North Reading Fire Station

B. Project Location:

152 Park Street
North Reading, MA

C. Owner:

Town of North Reading
Town Hall
235 North Street
North Reading, MA 01864
Contact Person: Michael Gilleberto, Town Administrator

D. Owner Project Manager:
The Vertex Companies, LLC
One Edgewater Drive, Suite 204
Norwood, MA 02062
Contact Person: Bryan Fors, Senior Project Manager

E. Architect:

HKT Architects
24 Roland Street, #301
Charlestown, MA 02129
Contact Person: William Hammer

F. Description of the Work:

The project is for the renovation of the fire department side of the North Reading public safety building at 152 Park Street. The police department side of the building is not part of the project scope, except where the new work requires transition to or re-working of systems or building components that interface between the two departments and replacement of existing roofing with new roofing to match. Sitework will require work to be performed on all four sides of the building. All work that will affect operations of the police department will need to be coordinated with the Police Chief and the Fire Chief to minimize disruption to police operations.

1. Preparation: Abatement of all hazardous materials, Asbestos testing has been performed on the fire department.
2. Preservation: Any significant change will need approval from the Historic District Commission
3. Structural Work: Strengthening the existing structure to support new floor, includes new columns, strengthening existing foundations, extending the apparatus bay, new stair tower and exterior passenger elevator.
4. Exterior Renovations and Modifications: Exterior modifications will require some patching and transitions where the police side of the building interfaces with new construction. New roof structure will need to be transitioned into the existing roofs of both the police and fire department sides of the building. New work will cover over existing exterior louvers facing the fire department and serving the police department HVAC system will need to be filled in and relocated as required per mechanical drawings. All existing exterior mounted Electrical and HVAC equipment on the fire department side will need to be removed. Items serving the police department will need to be relocated as coordinated with the police department.
5. Roof: New membrane roof on upper level including replacement on the existing Police and Fire structures to remain and replacement of all asphalt shingle roofs.
6. Interior Construction: New partitions, ceilings as shown on drawings and repair to exposed concrete floors on the basement and first floors.

7. New asphalt paving on the entire site, expansion of parking on the west side including new retaining wall, lighting and plantings
8. Mechanical Systems: All new MEP/FP systems
9. All new electrical systems including new generator and transformer.
10. Police Department: The adjoining half of the building shall be occupied by the North Reading Police Department. All work under this contract must protect their operations at all times. Close coordination of all activities that could disrupt the Police Department operations will be required.

1.4 CONTRACT CONDITIONS

A. This Contract is subject to applicable State and local laws and all amendments thereto. Where any requirements contained herein do not conform to statutes governing the Work of this Contract, the statutes shall govern.

B. This Project will be constructed for a political subdivision of the Commonwealth of Massachusetts and is therefore exempt from State Sales and Use Tax. All bids shall be prepared and purchase of materials for the Project made on the basis of such exemption. After execution of the Contract, the Owner will furnish the Contractor with the exemption number to be used.

C. The provisions of the Federal Occupational Safety and Health Act (OSHA) apply to the execution of the Work of this Contract, in addition to all other laws, ordinances, rules, regulations, and orders of any Federal, State, or local public authority bearing on the performance of the Work.

D. Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein and the Contract shall be read and enforced as though it were included herein, and if, through mistake or otherwise, any such provision is not inserted, or is not correctly inserted, then upon application of either part the Contract shall forthwith by physically amended to make such insertion or correction.

1.5 WORK SEQUENCE

A. General: The Contractor’s attention is directed toward the critical activities and limitations listed in this Article to highlight unusual conditions present in this Project.

1. The Contractor shall be responsible for scheduling the Work accordingly, and in conformance with requirements of all other specifications for the Project.
2. Sequencing requirements shall be clearly identified on all construction schedules required under Section 013200 – CONSTRUCTION PROGRESS DOCUMENTATION.

B. Documentation of Existing Conditions: Due to the historic nature of the building, the Contractor is required to prepare extensive documentation of the existing construction. The following work must be complete prior to commencement of demolition and construction on the site.

1. Photography: Documentation of existing exterior facades and interior surfaces. Refer to Section 013200 – CONSTRUCTION PROGRESS DOCUMENTATION.

    a. Photograph and dimension the existing cupola after removal prior to disposal.

2. Field Engineering: Establishment of precise horizontal and vertical reference points of items identified below in this Section.
3. This report must be submitted prior to commencement of the Work.

C. Owner Responsibility: Prior to commencement of construction at the site, the Owner will remove all furnishings and equipment to be saved and stored off-site and subsequently returned by the owner after taking possession of the completed project

1. Relocate all antenna cabling currently on apparatus bay roof to police side of the building.

D. Critical Activities: Each of the following critical activities must be completed prior to other construction activities as indicated:

1. Relocation of rooftop condensers and all items tied to the operation of police dept. side HVAC operations should be completed prior to demolition of the apparatus bay roof so the police dept. services are minimally affected.
2. Safe off and reroute connections as needed for all electrical serving the police dept. side of the building prior to demolition of electrical on the fire dept. side of the building. Start up of new transformer and utility tap box needs to be coordinated with the Police Dept. to ensure contniuous operations.
3. Safe off and reroute connections as needed for all fire protection serving the police dept. side of the building prior to demolition of fire protection on the fire dept. side of the building.
4. Safe off and reroute connections as needed for all domestic cold water serving the police dept. side of the building prior to demolition of domestic cold water on the fire dept. side of the building.
5. Reinforcement of existing walls in the apparatus bay prior to the installation of new structural members to support the new floor above.

E. Critical Submittals: No structural steel submittals will be reviewed by the Designer until product data and shop drawings for the following equipment has been submitted and approved:

1. Rooftop HVAC units.
2. Fan coil units.
3. Cooling tower.
4. Generator.
5. Transformer & Utility Tap Box

F. Weather Protection: Weather Protection: The Contractor’s attention is directed to the fact that extensive od the building is without a roof. Particular care is required, due to the Owner’s intent to preserve the historic fabric of the building. For additional requirements, refer to Section 015000 – TEMPORARY FACILITIES AND CONTROLS.

G. Air Barrier: Schedule the installation of materials comprising the exterior envelope to minimize exposure of construction materials to damage by ultraviolet light, wind and weather. Notify the Architect prior to concealment of air barrier, to permit inspection and testing. Refer to Section 014000 – QUALITY REQUIREMENTS, and individual technical specification sections for specific requirements.

1.6 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes providing support systems to receive Owner's equipment and making plumbing, mechanical, and electrical connections.

1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.

3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

B. New Owner-Furnished Equipment to be Installed by the Contractor:

1. SCBA Compressor
2. Air Compressor
3. SCBA Washer
4. SCBA Filling Station
5. Stacked Domestic Washer & Dryer

C. Existing Owner-Furnished Equipment to be removed, stored and reinstalled by the Contractor:

1. Clothes Washer
2. Commercial Clothes Dryer
3. Gear Extractor
4. Gear Drying Cabinet
5. Ice Machine
6. SCBA tank storage table

D. Note that items labeled “N.I.C.” on the Drawings will be furnished and installed by the Owner under a separate contract after the completion of the Work.

1.7 PERMITS, INSPECTION AND TESTING REQUIRED BY GOVERNING AUTHORITIES

A. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested, or approved, the General Contractor shall give the Designer and such Authority timely notice of its readiness so the Designer may observe such inspection and testing.

B. Prior to the start of construction, the General Contractor shall complete application for a Building Permit to the **[local building department].** Such Permit shall be displayed in a conspicuous location at the project site.

C. Payment requirements for this permit fee are waived by the Owner. Waiver of permit fee in this instance shall not be understood to apply to other permit and fee requirements for the Project.

D. Exterior Wall Assemblies: NFPA 285 is applicable to this project. Exterior wall products are specified in multiple specification sections, and multiple products are listed as acceptable

equals in those sections. Since not all products have been tested to meet NFPA 285 in all combinations, the Contractor shall coordinate with Subcontractors to ensure that the assembly of products meets NFPA 285 requirements. Provide documentation for exterior wall assemblies indicating compliance with NFPA 285 based on products proposed for use on this project.

1.8 REFERENCE STANDARDS

A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. The date of the standard is that in effect as of the bid date, except when a specific date is specified.

C. Obtain copies of standards when required by Contract Documents. Maintain copy at job sit during progress of the specific work.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat 2004 Edition" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. All instructions in the Specifications are addressed to the Contractor unless the responsibility of the Designer or Owner is clearly indicated.

    a. Where products are listed or described in outline form, the phrase “The Contractor shall furnish these products” is implied.
    b. Where installation instructions or performance criteria are listed or described in outline form, the phrase “The Contractor shall perform the Work in accordance with these requirements” is implied.
    c. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

C. Definitions:

1. Indicated: The word "indicated" refers to graphic representations, notes or schedules on Drawings, Paragraphs or schedules in Specifications, and similar requirements in Contract Documents. Terms such as "shown", "noted", "scheduled", and "specified" are used to help locate a reference. No limitation on location is intended except as specifically noted.
2. Directed: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted", are hereby defined as "directed by Designer", "requested by Designer", "authorized by Designer", etc. No implied meaning shall be interpreted to extend the Designer's responsibility into the Contractor's area of construction supervision.
3. Approve: The term "approved" when used in conjunction with the Designer's action on the Contractor's submittals, applications, and similar requests, is limited to the duties and responsibilities of the Designer as stated in GENERAL CONDITIONS. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.
4. Furnish: Supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
5. Install: Operations at Project Site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
6. Provide: To furnish and install, complete and ready for intended use.
7. Installer: The Contractor or entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
8. Owner: The Awarding Authority.
9. Authority having Jurisdiction: Any State, Local, or legal authority, as defined by statute.

D. “Or Equal”, “Or Equivalent”: clause:

1. Where products or materials are prescribed by manufacture name, trade name or catalogue reference, the word “or approved equal” shall be understood to follow.
2. An item shall be considered equal or equivalent to the named item, if all of the following conditions are met:

    a. It is at least equal in appearance, quality, durability, strength and design.
    b. It meets or exceeds all performance requirements specified.
    c. It performs the function of the item to an equal or superior standard as does the named item.

3. All deviations from products specified shall be submitted as substitutions. For related procedures, refer to Section 013300 – Submittal Procedures.

1.10 MISCELLANEOUS PROVISIONS

A. Discovery: If during the excavation or other work, articles of unusual value, or of historical or archaeological significance are encountered the ownership of such articles is retained by the Owner, and information regarding their discovery shall be immediately furnished to the Designer.

1. If the nature of the article is such that the work cannot proceed without danger of damaging same, work in that area shall be immediately discontinued until the Designer has decided the proper procedure to be followed.
2. Any time lost thereby shall be a condition for which the time of the Contract may be extended.

3. All costs incurred after discovery in the salvaging of such articles shall be borne by the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 011400

WORK RESTRICTIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. Contractor responsibility for Architect's additional services.
2. Construction Documents, Project Electronic Files and graphic reproduction of Contract Documents.
3. Interpretation and modification of Contract Documents.
4. Contractor's reports.
5. Storm water pollution protection plan
6. Cleaning materials
7. Safety and disposal requirements.
8. Conduct of the Work.
9. Hours of work.
10. Contractor use of premises.
11. Existing Utilities.
12. Noise control.
13. Safety and disposal requirements and accident prevention.
14. Welding and cutting.
15. Municipal police services
16. Storage of materials off-site
17. Dust control.
18. Cleaning during construction.
19. Debris control and removal of rubbish.
20. Pollution control.
21. Owner's occupancy requirements

B. Related work includes, but is not limited to, the following work under other Sections:

1. Section 013200 – CONSTRUCTION PROGRESS DOCUMENTATION: Preparation and execution of construction schedule.
2. Section 013100 – PROJECT MANAGEMENT COORDINATION: Procedures and responsibilities for coordinating the Work.
3. Section 013300 – SUBMITTAL PROCEDURES. Submittal procedures.
4. Section 015000 – TEMPORARY FACILITIES AND CONTROLS, for additional information on temporary measures required during construction.
5. Section 017400 – CONSTRUCTION WASTE MANAGEMENT, for removal of non-hazardous debris including provisions for recycling and disposal.
6. Section 017700 – CLOSEOUT PROCEDURES: Procedures for completing the Work.

7. Section 017839– PROJECT RECORD DOCUMENTS: Preparation of record drawings and other documents.
8. Section 018119 – INDOOR AIR QUALITY REQUIREMENTS, for procedures for maintaining good indoor air quality in completed building.

1.3 SUBMITTALS

A. General: Refer to Section 013300 – SUBMITTAL PROCEDURES, for submittal provisions and procedures.

B. Layout of Temporary Construction Facilities: Submit location plan showing office, trailer and storage layout.

C. Logistics Plan:

1. Contractor shall submit to the Owner's Project Manager, at the Pre-construction Meeting, a detailed Logistics Plan, which shall include:

    a. Delivery Hours and Delivery Routes
    b. Gate location, and wheel washing location.
    c. Hours of Work
    d. Trailer Area, and Layout of trailers
    e. Parking locations for use of Owner and Contractor within the area of work
    f. Temp fencing, erosion control, and metering locations
    g. Location for stockpiling of soil
    h. Location for stockpiling plowed snow
    i. Locations for waste management containers.
    j. Protection of existing curbs and walkways.
    k. Lighting Plan

2. Refer to Section 015000 – TEMPORARY FACILITIES AND CONTROLS, for specifications for temporary construction and other items to be shown on Logistics Plan.
3. No work shall commence until the Logistics Plan has been approved.

D. Reports:

1. Documentation of off-site storage facilities.
2. With each Application for Payment, submit the following reports, compiled on a monthly basis:

    a. Contractor's Reports
    b. Proof of submission of Certified weekly payrolls to Owner.

E. Storm Water Pollution Prevention Plan Documentation: Submit copies of the following documents for information and record purposes only, including one extra copy of each submittal, for the Owner's use in keeping the North Reading Conservation Commission informed of the progress of the Work:

1. Storm Water Pollution Prevention Plan (SWPPP)
2. Notice of Intent (NOI)
3. Notice of Termination (NOT).
4. Updates to SWPPP

1.4 CONTRACTOR RESPONSIBILITY TO THE OWNER FOR ARCHITECT'S ADDITIONAL SERVICES

A. The Contract between the Owner and the Architect contains provisions for additional services that may be required of the Architect during construction due to unforeseen conditions.

1. Where such additional services become necessary due to the activities of the Contractor, as determined by the Owner's Project Manager, costs for such services will be the responsibility of the Contractor, and will be deducted from the Contract Amount.

B. Additional services for which the Contractor is responsible for cost to the Owner may include the following activities of the Architect:

1. Review of Requests for Information and Change Order Requests for work determined to be covered in the Contract Documents. Refer to related Articles in this Section.
2. Continuation of construction administration beyond the dates specified for Final Completion of the Work: Refer to Section 013200 – CONSTRUCTION PROGRESS DOCUMENTATION.
3. Review of re-submitted submittals and Substitution Requests that have been rejected: Refer to Section 013300 – SUBMITTAL PROCEDURES.
4. Re-inspection of incomplete work: Refer to Section 017700 – CLOSEOUT PROCEDURES.
5. Design services for the resolution of non-conforming work.

1.5 CONSTRUCTION DOCUMENTS

A. The General Contractor and each Subcontractor shall retain copies of the Contract Documents issued to them for bidding purposes.

1. The Owner will furnish to the General Contractor, without additional charge, an additional ten (10) complete sets of the Contract Documents, including Drawings and Specifications, for use during the construction period.
2. The Owner will furnish to each Sub-Contractor, without additional charge, two (2) additional copies of those Drawings and Specifications directly related to the work of their respective trades for use during the construction period.
3. Extra sets returned by bidders and not required for other purposes, as determined by the Owner's Project Manager, will be made available to Contractor and Subcontractors for the Work.

B. All other hard copies of the Contract Documents required by the Contractor or Subcontractors for use during the construction period shall be purchased by the party requiring same. Owner's Project Manger will furnish approximate costs of such additional copies and will transmit originals to local printing companies with whom he regularly does business, but will not receive bills for such printing through his account. All negotiations for such printing shall be between Contractor and Printer.

1. Refer to provisions in this Section, for electronic copies of documents to be made available for the Contractor's use during construction.
2. Refer to Section 017839 – PROJECT RECORD DOCUMENTS, for additional sets to be provided by the Owner to the Contractor for the purpose of maintaining record prints of the Work as construction proceeds.

1.6 PROJECT ELECTRONIC FILES

A. Definitions:

1. Contract Documents: Printed hard copies of drawings and other documents, as defined in the General Conditions and listed in the signed copy of the Form of Agreement between Owner and Contractor.

    a. In case of conflict between the Contract Documents and documents obtained through electronic means, the Contract Documents shall govern.

2. Project Electronic Files: Electronic copies of electronic documents for the Project, comprising drawings listed on Document 011401 – Electronic Release Form.

B. General Procedures: At the Pre-Construction Meeting, the Architect will present to the Contractor one compact disc (CD) with Project Electronic Files, for use in the preparation of coordination and record documents for the Project.

1. Release Forms Required:

    a. The Contractor shall sign a copy of Document 011401 – Electronic Release Form, to be filled out and issued by the Architect.
    b. By signing the release form, the Contractor is acting on behalf of all their subcontractors for the Work of this Project.

2. Additional copies of the compact disc with Project Electronic Files will be available from the Architect at an additional cost.

C. Electronic File Format:

1. Editable Files: Electronic files for drawings listed on Document 011401 – Electronic Release Form will be furnished in "*.DWG" format.
2. Printable, Non-Editable Files: Electronic files for all Drawings in the Bid Set and for Drawings issued as Addenda will be furnished in "*.PDF" format (Adobe Acrobat Reader, version 6.0).
3. The Architect does not warrant that these electronic documents are compatible with any software or hardware other than those on which they were produced.

D. Permitted Use of Project Electronic Files: Use of electronic files by the Contractor and Sub-Contractors is limited to the following activities:

1. Project Electronic Files may be used as a guide only for the preparation of Coordination Drawings and Record Drawings to be submitted as a requirement for the Project.
2. Project Electronic Files may be used as a guide only for preparation of shop drawings. Exact copies of Contract Documents will not be accepted if submitted for these purposes, unless specifically permitted by an individual specification Section.

E. Responsibilities of Contractor: Use and reproduction of Project Electronic Documents are subject to the following conditions:

1. The use of Project Electronic Files, reproduced either electronically or by other graphic reproduction methods, does not in any way alter the responsibilities of the Contractor for final system coordination. The Contractor shall incur all liability in this respect.
2. The Contractor and all Subcontractors are responsible for checking the dimensions and completeness of the Project Electronic Files, and for determining any possible errors and omissions, as required by the General Conditions.

3. The Contractor is responsible for updating Project Electronic Files as necessary to incorporate changes to the Work shown in Addenda and documents issued during construction.
4. In no event shall the Architect or any other Person or Firm involved in the creation, production or distribution of the reproducible or electronic documents, be liable to the persons utilizing the documents, on account of any claim for damages. Each Person or Firm utilizing these documents agrees to release, indemnify, hold harmless and defend the Architect, its officers, employees and consultants from an against all liability arising out of such firm's use of the electronic or reproduced documents or information referred to herein.

F. Ownership of Documents: By transferring copies of Project Electronic Files, the Architect does not in any way convey the copyright in the designs contained therein, nor do they convey a license to copy or use them for any purpose except as required for the construction of the Project.

G. License for Software: By transferring copies of Project Electronic Files, the Architect does not in any way convey transfer license to use the software on which the documents were prepared. Each entity using Project Electronic Files is responsible for obtaining licenses as needed for its use of those files.

1.7 GRAPHIC REPRODUCTION OF CONTRACT DOCUMENTS

A. Reproduction of Contract Documents issued for the Project, by graphic reproduction methods, shall be subject to the conditions outlined for reproduction of Project Electronic Files.

1.8 INTERPRETATION AND MODIFICATION OF CONSTRUCTION DOCUMENTS

A. Refer to General and Supplementary Conditions for general information on Change Orders, Work Change Directives, Field Orders and Architect's written amendments and clarifications. The intent of this Article is to provide for additional procedures to be followed during construction.

B. Requests for Information: Each time the Contractor or Subcontractor has a reasonable question on the interpretation of the Contract Documents, they shall submit in writing a Request for Information (RFI) to the Architect for response.

1. The Contractor shall examine field conditions carefully and review the Drawings and Specifications thoroughly prior to issuing an RFI.
2. The Contractor shall keep a log of RFI's, numbering them in the order in which they are issued.
3. Each RFI shall contain a clear statement of the question, references to relevant Contract Documents and additional background information as needed to facilitate the Architect's review.
4. All requests for information from Subcontractors shall be made through the Contractor and addressed to the Architect, and the Architect will distribute them as needed to the appropriate Consultants. A copy of each RFI shall be given to the Clerk of the Works.
5. RFI's shall be issued in a timely manner to permit a thorough review and preparation of a response by the Architect and their Consultants.
6. The Architect will prepare a written response to each RFI within 10 workdays, or sooner if the Contractor provides a realistic date when the response will be needed.

C. Proposal Requests: During construction, it may become necessary or desirable to modify the Contract Drawings or Specifications in response to concealed existing conditions, changes in the Owner's program or other unforeseen circumstances.

1. Where such a modification may involve a change in the Contract price or time, the Architect will prepare a Proposal Request describing the modification under consideration, including sketches or drawings, specifications and other information to permit pricing by the Contractor.
2. Copies of each Proposal Request and its attachments will be distributed to the Owner, Clerk of the Works and Contractor.
3. The Contractor shall respond in a timely manner with a Proposed Change Order detailing the estimated costs and change in Contract duration, for review by the Architect and approval by the Owner.
4. A Proposal Request will not constitute direction to proceed with the modification unless accompanied by a Work Change Directive and an estimated price.

D. Change Order Requests: If the Contractor is required to perform Work that they consider to represent a change in the cost of the Project, they may submit Change Order Requests for such work.

1. Each Change Order Request shall be accompanied by a document describing the modification under consideration, including sketches or drawings, specifications and other information to permit review of pricing by the Architect and Owner.
2. Distribute copies of each Change Order Request and its attachments to the Owner, Clerk of the Works and Architect.
3. The Architect and Owner will respond in a timely manner with a Proposed Change Order incorporating the Change Order Request if it is approved.
4. Verbal approval of a Change Order Request will not constitute direction to proceed with the modification unless accompanied by a Change Order, or a Construction Change Directive with an estimated price.

E. Architect Review of Contractor-Generated Requests for Information and Change Order Requests: The Architect will review and prepare written responses to the Contractor’s Requests for Information and Change Order Requests that are submitted in accordance with the requirements of this section.

1. If the Contractor submits an excessive number of requests for information that are incomplete, or for which the information requested is available from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared or other prior Project correspondence or documentation, then the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to review those requests for information.
2. If the Architect determines that the Work covered by a Change Order Request is covered by the scope of the Contract Documents, the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to evaluate proposals and prepare Instruments of Service associated with such Change Order Request.
3. Refer to other paragraphs in this Section for procedures required in cases where Contractor is responsible to the Owner for costs for Additional Services of the Architect.

1.9 CONTRACTOR'S REPORTS

A. A daily report summarizing the work performed, weather conditions, number of workers, amount and kinds of equipment, unusual occurrences, and the like shall be submitted by the Contractor's Field Superintendent to the Architect, the Owner, the Clerk of the Works, each working day covering the work performed on the previous working day.

B. Form of the daily report shall be as approved by the Architect.

C. Attention is directed to recent amendments to MGL Chapter 149, Section 27B requiring submission of certified weekly payrolls directly to the Awarding Authority by every contractor and subcontractor doing public work.

1.10 STORM WATER POLLUTION PREVENTION PLAN

A. Storm Water Pollution Prevention, General: The General Contractor shall submit and execute a Storm Water Pollution Prevention Plan (SWPPP) in accordance with requirements of the National Pollutant Discharge Elimination System (NPDES), administered by the United States Environmental Protection Agency (EPA). The purpose of this plan is to prevent pollution of storm water due to construction activities, throughout the period of construction.

1. Contractor responsibilities include:

a. Temporary construction and maintenance of storm water control and pollution abatement features.
b. Construction practices that prevent pollution of storm water.
c. Record keeping.
d. Periodic inspections
e. Modification of the SWPPP as required to address unanticipated conditions.
f. Notification to the Owner and Architect of changes in SWPPP required due to changes in the Work.
g. Preparation and filing of Notice of Intent and Notice of Termination.

2. The SWPPP shall conform to the requirements of the North Reading Conservation Commission where applicable, as stated in ORDER OF CONDITIONS and associated attachments.
3. Refer to Document C2.1 DEMOLITION, EROSION, & SEDIMENT CONTROL PLAN, ORDER OF CONDITIONS, and Section 313200 Erosion and Sedimentation Control for additional requirements for control of storm water during construction.

B. Storm Water Pollution Prevention Plan: Prepare a plan that complies with the requirements of the NPDES General Permit for Storm Water Discharges From Construction Activities, developed by the United States Environmental Protection Agency in accordance with the provisions of the Clean Water Act, 33 U.S.C. §1251 et sequ., as amended by the Water Quality Act of 1987, P.L. 100-4. The SWPPP shall include text and drawings with the following information:

1. Identification and contact information for all Contractors at the project site whose activities may have an impact on storm water pollution.
2. Description of construction site and activities, with identification of potential sources of storm water pollution.
3. Description of pollution control measures that will be implemented and maintained during construction to stabilize slopes and prevent pollution from entering storm water.
4. Additional information as required by EPA.

C. Notice of Intent: After the SWPPP has been completed, the Contractor shall prepare, sign and file a Notice of Intent (NOI) with EPA, using a copy of the Notice of Intent for Storm Water Discharges Associated with Construction Activity Under an NPDES General Permit attached to this Section.

D. Notice of Termination: When site conditions have been stabilized, vegetation has been established and sources of construction-related pollution of storm water have been removed, the Contractor shall prepare, sign and file a Notice of Termination (NOT) with EPA, in

accordance with NPDES General Permit for Storm Water Discharges From Construction Activities.

E. On-Site Records: The Contractor shall maintain up-to-date records of SWPPP documentation in their site office. Required records include:

1. Copy of completed SWPPP
2. Copies of NOI and NOT as filed with EPA.
3. Inspection reports
4. Maintenance reports
5. Construction activity reports
6. Spill records
7. Additional record copies in accordance with NPDES General Permit for Storm Water Discharges From Construction Activities.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Use only those materials which will not create hazards to health or property and which will not damage surfaces. Refer to Section 018119 – Indoor Air Quality Requirements for additional requirements.

B. Use only those cleaning materials and methods recommended by manufacturer or surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 CONDUCT OF WORK

A. The Contract Site shall be as shown on the Drawings and shall include the entire area bound by the "Contract Limit" or "Limit of Work" lines as well as all areas outside of the Limit of Work Lines when required for performance of work under this Contract.

B. Contractor shall take all steps necessary to protect existing conditions to remain. Damage to existing work caused by Contractor's operations under this Contract shall be repaired at Contractor's expense.

C. Any street, paving, curb and/or sidewalk damaged as the result of work under this Contract, whether within or outside the limits of the Work, shall be repaired and/or replaced with new matching construction by the Contractor at his expense and in a manner satisfactory to the Architect and authorities having jurisdiction.

D. Protection of Curbs and Walkways: Where existing curbs or walks are to remain, or after new curbs or walks are constructed and trucking is required over them, they shall be suitably protected as shown on approved Logistics Plan.

E. Trenching and other work outside construction limits shall be expedited to the fullest and carried out with minimum of inconvenience to normal operations of Owner and public traffic. Walks, paved or landscaped areas over which temporary driveways cross shall, upon completion of the

Work, be restored to their original condition with new construction. Temporary roadways shall be bridged over trenched areas.

F. Provide continuous, lawful, safe, adequate and convenient access to the site. Contractor shall construct and maintain in good, safe, usable condition temporary roads, capable of supporting emergency vehicles, and appurtenances as required, and when no longer required, remove temporary construction and restore such areas to their original condition, or as otherwise specified in the Contract Documents.

G. Conduct of Construction Personnel: Smoking is not permitted on project property, including the construction site.

3.2 HOURS OF WORK

A. Hours of work shall be from 7:00 AM until 7:00 PM, excluding Sundays, and Holidays, unless otherwise approved by the Owner.

B. The Contractor shall comply with applicable local ordinances.

3.3 CONTRACTOR USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period.

1. Confine operations at the site to areas permitted by laws, by-laws, permits and contract limit lines.
2. Do not unreasonably encumber the site with materials or equipment.
3. Coordinate with Owner and Architect work in connection with adjacent occupied buildings or areas, driveways, walks, and other facilities which would prevent access thereto or interrupt, restrict, or otherwise infringe upon use thereof.

B. General: Contractor will have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

C. Use of Site: Limit use of premises to areas within the Contract limits indicated on Drawings. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Schedule any work that will obstruct adjacent streets in accordance with the requirements of the Owner.
2. Maintain access to existing walkways, streets and other adjacent occupied or used facilities. Do not close or obstruct walkways, streets or other occupied or used facilities without written permission from Owner and other authorities having jurisdiction.
3. Owner Occupancy: Allow for Owner occupancy of portions of Project site, including adjacent occupied buildings, and use by the public.
4. Driveways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

5. Site Access: Owner will designate access roads to site and will define limits within which Contractor shall control movements of his personnel. Access to the site shall generally be

via existing roadways and paved surfaces which Contractor shall maintain and restore to original condition.

D. Use of Existing Building: Maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

E. Contractor Parking: Parking of Contractor's vehicles and those of his Subcontractors will be coordinated with the Town Fire and Police Departments and subject to their approval. Contractor shall be responsible for parking arrangements, regulation and control of such parking and resulting traffic. Each Subcontractor shall make arrangements with Contractor for required parking of his vehicles.

F. On-Site Delivery and Storage of Construction Materials: Do not permit materials and fabricated work to be stacked on, or be transported over, floor and roof construction in such a manner as to stress any construction beyond the designed live loads. Assume full responsibility for protection and safekeeping of products stored on premises. Obtain and pay for use of additional storage or work areas needed for operations. Limit use of site to work and storage of materials for this project.

1. Maintain clean, dry storage areas for construction materials and minimize their exposure to dust. Refer to Section 018119 – Indoor Air Quality Requirements and individual Division 3 through 50 Sections for additional requirements.
2. Do not store foamed polystyrene, polyurethane or like materials within the building. Take proper precautionary measures regarding the Storage of such materials outside the building.

G. Contractor shall be responsible for adequate site drainage during the entire construction period and shall use any appropriate temporary means that does not adversely affect construction progress or abutting property. Refer to Section

H. Contractor shall take all necessary safety precautions and maintain an adequate level of fire protection at all times.

I. Do not use areas outside the Limit of Work area for temporary storage or structures without specific written permission from the Architect and Owner.

3.4 EXISTING UTILITIES

A. Existing Utility Interruptions: 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 Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

B. Immediately repair any active existing utility lines (cables, conduit, ducts, and piping), damaged during the course of construction. Protect and maintain such active existing utilities in use, until relocation of same has been completed or utilities have been cut, capped, or prepared for new service connections, as applicable. Perform such repair and protection work at no additional cost to the Owner.

C. If any existing active utility not indicated on the Drawings is unintentionally damaged, and such utility is to remain, immediately repair the damage and restore the utility to its original integrity.

Reimbursement of cost for performing such repair will be made by an adjustment in the Contract Price in accordance with the General Conditions of the Contract.

D. Any adjustment as outlined above shall be based on the assumption that the Contractor has performed in a prudent manner at the time such damage occurred. If extra expense is incurred in protecting and maintaining any utility line not shown on the Drawings, nor revealed by a “Dig-Safe” inspection, an adjustment in the Contract Price shall be made.

E. The Owner will cooperate and assist the Contractor in locating and identifying underground utilities. Contractor shall cooperate and participate in "Dig Safe" programs, notifying proper authorities before proceeding.

F. If it becomes necessary to interrupt power, water line, sewer, gas or other utilities to adjacent buildings, notify the Architect and Owner's Project Manager at least four (4) days in advance. Schedule such interruptions at such times as will minimize disruption and inconvenience to users.

3.5 NOISE CONTROL

A. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum. Submit noise abatement program to Owner's Project Manager and Architect for review prior to use of noise generating equipment.

B. Execute construction work by methods and by use of equipment that will reduce noise and which will provide minimum interference with neighborhood activities.

1. Employ construction methods and equipment that will produce the minimum amount of noise.
2. Equip air compressors with silencers, and power equipment with mufflers.
3. Handle vehicular traffic and scheduling to reduce noise.

C. Do not allow radio and electronic entertainment equipment to be operated at volume that makes ordinary conversation difficult at ten (10) feet from such equipment.

3.6 SAFETY AND DISPOSAL REQUIREMENTS

A. Standards: Maintain project in accordance with State Building Code and local ordinances.

B. Hazards Control: Store volatile wastes in covered metal containers and remove from premises. Prevent accumulation of wastes which create hazardous conditions. Provide adequate ventilation during use of volatile and noxious substances.

C. Disposal: Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws. Do not burn or bury rubbish and waste materials on project site. Do not dispose of hazardous wastes such as solvents, mineral spirits, oil, paint, paint thinner in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

3.7 ACCIDENT PREVENTION

A. Comply with all Federal, State and municipal recommendations and requirements for safety and accident prevention, those of the Associated General Contractors of America and the American National Standards Institute (ANSI Standard A10.2). Conduct regular, frequent inspections of the site for compliance with safety regulations.

B. Neither the Owner nor the Architect will be responsible for providing a safe working place for the Contractor, Subcontractors, or their employees, or any individual responsible to them for the Work.

3.8 WELDING AND CUTTING

A. Where electric or gas welding or cutting work is done above or within ten (10) feet of combustible material or above space that may be occupied by persons, use interposed shields of incombustible material to protect against fire damage or injury due to sparks and/or hot metal.

B. Place tanks supplying gases for gas welding or cutting at no greater distance from the work than is necessary for safety, securely fastened and maintained in an upright position where practicable. Such tanks, when stored for use, shall be remote from any combustible material and free from exposure to the direct rays of the sun or high temperatures. Storage shall be secured under lock and key, to prevent unauthorized use of gas and equipment.

C. Maintain suitable fire extinguishing equipment near all welding and cutting operations. When operations cease for the noon hour or at the end of the day, thoroughly wet down the surroundings adjacent to welding and cutting operations. Properly protect any new materials, stored or installed, that are subject to water damage.

D. Station a worker equipped with suitable fire extinguishing equipment near welding and cutting operations to see that sparks do not lodge in floor cracks or pass through floor to wall openings or lodge in any combustible material. Keep the worker at the source of work which offers special hazards for a minimum of thirty (30) minutes after the job is completed to make sure that smoldering fires have not been started.

E. Place a qualified electrician in charge of installing and repairing electric and arc welding equipment.

3.9 MUNICIPAL POLICE SERVICES

A. Make all necessary arrangements with the municipal police department in advance of times when regular, off-duty, or reserve police officers will be needed for traffic control or protection due to operations performed under this Contract.

B. Pay police officers in accordance with rates established by the municipality for such services:

C. Extend the Worker's Compensation Insurance and Employer's Liability Insurance required under the General Contract to cover police used on the Project.

3.10 STORAGE OF MATERIALS OFF SITE

A. The Contractor, Subcontractors and Sub-subcontractors shall obtain prior written approval from the Owner through the Architect for permission to store materials to be incorporated in the Work, for which Progress Payments will be requested, at off-site locations. Any and all charges for storage, including insurance, shall be borne solely by the Contractor. Before approval, Owner will require proper proof of insurance and a letter in which is furnished:

1. The names of the Contractor and/or Subcontractor or subordinate Subcontractor leasing the storage area.
2. The location of such leased space.
3. Description of the leased area: The entire premises or certain areas of a warehouse giving the number of floors or portions thereof.

4. The date on which the material is first stored.
5. The value of the material stored.
6. Transfer of title for such materials in a form acceptable to the Owner.

B. Requirements for storage facility at which materials will be stored off-site:

1. The storage facility shall be a bonded warehouse.
2. The Contractor shall permit access to the storage facility to the Clerk of the Works upon request.

C. Contractor, Subcontractors and subordinate Subcontractors shall provide prior to the request for payment for such stored materials, adequate advanced notice, to the Architect so that the Owner or Architect can inspect, at their convenience, the materials being stored at any location.

D. Each sealed carton shall be marked with the Project name, the Owner's name and the Architect's name as they appear in the Agreement.

E. A perpetual inventory shall be maintained for all materials held in storage for which payment has been requested.

F. Payment for materials stored off site shall be at the sole discretion of the Owner. Any additional costs to the Owner resulting from storage of material off site for which payment is requested, such as, but not limited to, travel expenses and time for inspectors shall be back charged to, and paid by, the Contractor.

3.11 DUST CONTROL

A. Maintain the construction site, stockpiles, access, detour, and haul roads, staging and parking area used for the Work, free of dust which would cause a hazard or a nuisance to those at the site or adjacent sites.

B. Provide environmentally safe and positive methods and dust control materials to minimize raising dust from construction operations and provide positive means to prevent air-borne dust from dispersing into the atmosphere.

C. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

D. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

E. Schedule operations so that dust and other contaminants resulting from 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.

G. These provisions do not supersede any specific requirements for methods of construction or applicable regulations or general conditions set forth elsewhere in the Contract with regard to performance obligations of the Contractor.

3.12 CLEANING DURING CONSTRUCTION

A. Execute cleaning during progress of work and at Substantial Completion, as required by General Conditions and as herein specified.

B. Maintain premises and public properties free from accumulations of waste, debris and rubbish caused by operations. At completion of work, remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all exposed surfaces; leave project clean and ready for occupancy.

C. Cleaning shall be in addition to cleaning specified under other sections and shall include all surfaces, interior and exterior in which or to which the Contractor has had access.

D. Refer to Sections of the Specifications for cleaning of specific products.

E. Execute cleaning to ensure that the building, the site, and adjacent properties are maintained free from accumulations of waste materials and rubbish and windblown debris, resulting from construction operations.

F. Provide on-site containers for collection of waste materials, debris and rubbish.

G. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal areas off site.

H. Handle materials in a controlled manner with as few handling as possible. Do not drop or throw materials from heights.

I. Schedule cleaning operations so that dust and other contaminants resulting from cleaning processes will not fall on wet newly painted surfaces, uncured caulking, sealants, adhesives, etc.

3.13 DEBRIS CONTROL AND REMOVAL OF RUBBISH

A. Ensure that each Subcontractor engaged in the Work bears full responsibility for cleaning up during on a daily bases and immediately upon completion of his work, and removes all rubbish, waste, tools, equipment, and appurtenances caused by and used in the execution of his work; but this shall in no way be construed to relieve the General Contractor of primary responsibility for maintaining a clean building and site free of debris, leaving all work broom clean and in a condition satisfactory to the Architect, Project Manager, and Owner.

B. Provide at least one tightly built chute serving each level which shall lead down to angle offset and sliding panel chute at a convenient loading point for trucks or dumpsters.

C. Do not permit any material to be thrown from open floors, windows or roof of the building.

D. Immediately after unpacking, remove all packing materials, case lumber, excelsior, wrapping and other rubbish, flammable and otherwise, from the building and premises.

E. Initiate and maintain a specific program to prevent the accumulation of debris at the construction site, storage and parking areas, or along access roads and haul routes:

Provide containers for deposit of debris and schedule periodic collection and disposal of debris. Prohibit overloading of trucks to prevent spillage on access and haul routes.

F. Contractor shall make provisions for snow and ice removal, as required. In addition Contractor shall provide wheel-washing stations at site egress gates, as directed by the Project Manager, to maintain clean neighborhood streets.

3.14 POLLUTION CONTROL, GENERAL

A. Provide methods, means and facilities required to prevent contamination of soil, water and atmosphere by the discharge of noxious substances from construction operations.

B. Remediation of Spills: Provide equipment and personnel, perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids. Excavate and dispose of contaminated earth off site and replace with suitable uncontaminated compacted fill and topsoil, in accordance with the requirements of Section 310000 - EARTHWORK.

C. Take special measures to prevent harmful substances from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams or in sanitary or storm sewers.

D. Provide systems for control of atmospheric pollutants. Prevent toxic concentrations of chemicals. Prevent harmful dispersal of pollutants into the atmosphere.

E. Refer to construction phasing plans for information and to the Order of Conditions for sequence of operations for erosion control.

3.15 STORM WATER POLLUTION PREVENTION PLAN IMPLEMENTATION

A. Execute Storm Water Pollution Prevention Plan described in SWPPP as submitted to the EPA, in accordance with Federal and local regulations.

3.16 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy adjacent buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing street and site access at all times, unless otherwise indicated.

1. Maintain access to existing walkways, streets and other adjacent occupied or used facilities. Do not close or obstruct walkways, streets or other occupied or used facilities without written permission from Owner, and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On

occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.

4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

C. If the Project is substantially complete by the specified date for Substantial Completion, the Owner at his election may from time to time, or permanently, occupy the building or any portion thereof as the work is completed to such a degree as will, in the opinion of the Owner, permit the use of the building or other portions of the Project for the purpose for which they are intended.

D. The Owner will, prior to any such partial occupancy, give notice to the Contractor thereof and such occupancy shall be predicated upon the following conditions:

1. In the case of partial occupancy prior to the stipulated completion date, the Owner shall secure endorsement from the Contractor’s insurance carrier and consent of the surety permitting occupancy of the building or use of the Project during the remaining period of construction.
2. In the case of partial occupancy after the stipulated completion date, the Contractor shall extend all the necessary insurance coverage as stipulated until the date of Final Acceptance of the Project. Owner's use and occupancy prior to final Acceptance shall not relieve the Contractor of his responsibility to maintain the insurance coverage as required by the Contract Documents.
3. In case of such partial occupancy, the guarantee period called for by the Contract Documents shall commence on the date of Substantial Completion of the Phase containing the guaranteed Work.
4. Occupancy of the building or any portion thereof by the Owner, shall not constitute an acceptance of the Work or of work not performed in accordance with the Contract Documents or relieve the Contractor of responsibility to perform any work required by the Contract but not completed at the time of occupancy.
5. If the Owner occupies the building as a result of the Contractor’s failure to substantially complete the work by the specified date, the Contractor shall pay maintenance costs on the portion of the building occupied under this Agreement until Substantial Completion.
6. The Contractor shall be required to furnish heat, electricity and water used in the occupied portion of the building, from the time of the occupancy by the Owner until Substantial Completion.

END OF SECTION

FORM 011401

ELECTRONIC RELEASE FORM

To: **[Contractor]**
[Street]
[Town, State]

Date: **[Date documents are transmitted]**

Project: North Reading Fire Station

RE: Project Electronic Files

Project Electronic Files are made available to the undersigned with the following conditions:

The undersigned agrees to accept from HKT Architect, Inc. the electronic files for the referenced project, as listed in the attached table, without any warranties, guarantees and/or representations of any nature whatsoever regarding the correctness, accuracy and/or completeness of any information contained therein.

The undersigned further agrees that such information shall be used as reference material only and then only for the referenced project and not for any other projects or future additions to the referenced project, without express written consent from HKT Architect, Inc. for each instance.

The undersigned further agrees to release, indemnify, hold harmless and defend HKT Architect, Inc. with respect to any claims, costs, losses, damages and/or liabilities arising out of, or relating to the use, misuse, modification, interpretation, misinterpretation and/or misrepresentation of any such information.

The undersigned further agrees to the requirements and limitations for the use of Project Electronic Files as stated in Section 011400 - Work Restrictions.

Sincerely,
HKT Architect, Inc.

Accepted and Agreed to:

_____

(General Contractor)

By: _____

Title: _____

END OF FORM

SECTION 012400

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 summary

A. The Work of this Section includes requirements for the following procedures:

1. Preparation and submittal of the Preliminary and Final Schedule of Values

B. Related work includes, but is not limited to, the following work under other Sections:

1. Requirements for construction schedules: Section 013200 – Construction Progress Documentation.
2. General procedures for submittals: Section 013300 – Submittal Procedures.

1.3 Definitions

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 Submittals

A. Prepare and submit the following submittals in accordance with the requirements of Section 013300 – Submittal Procedures.

B. Schedule of Values:

1. Schedule of Values shall be typewritten on 8-1/2 by 11 inch white paper.
2. Submit to the Architect three (3) copies of each Schedule of Values within 7 days of receipt of Notice to Proceed.

C. List of Subcontractors and Sub-subcontractors: Attached to the Preliminary Schedule of Values shall be a list of the names, addresses (and whether individual, partnership or corporation) of each Subcontractor or Sub-Subcontractor who is to perform all or any part of each subdivision. In the event any Subcontractors, or Sub-subcontractors are not known at the time said schedule is prepared, an amended or supplementary list containing the names of the Subcontractors and Sub-Subcontractors involved and indicating their division of the Work shall be furnished to the

Architect as soon as the information is available. A code number for identification on requisitions shall be used to identify the Contractor, each of the Subcontractors and subordinate Subcontractors, and shall be shown in each requisition where any part of the Work performed by the Contractor, such Subcontractor, Sub-Subcontractors or material supplier is incorporated in the amount of the requisition for which payment is requested.

D. Monthly Updates: Submit to the Owner with the Schedule of Values on a monthly basis such schedules of quantities and costs, payrolls, reports, estimates, records, and other data as the Owner may request concerning work performed or to be performed under this Contract. The Schedule of Values shall be submitted at the same time as the updated CPM Schedule showing the current status of the work, as required under Section 013200 – Construction Progress Documentation.

1.5 SCHEDULE REQUIREMENTS

A. General: Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project CPM Schedule. Provide line items for principal subcontract amounts, where appropriate, and for portions of the work designated in this Section.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section. Identify each line item by Specification Number and Title, and by portion of the Work of that Section where the Work of a Section is allocated to more than one line item.

C. The Schedule of Values shall be arranged in vertical columns identified with titles, including Names Of Items; Original Amounts, Percent Completed To Date; Previous Payments; Current Requests; and Balance Not Yet Requested. A summary of the total amount due to date and the amount of the five percent retained shall be included in the statement which shall be signed by the Contractor. A separate sheet shall be included with each requisition showing status of work covered by approved Change Orders. The Schedule of Values shall be revised if later found by the Architect to be inaccurate.

D. In preparing the Schedule, each sub-division or classification of the Work shall be identified by code number referring to each individual Section (or Sub-Section where applicable) of the Specifications. The Schedule of Values shall be prepared in accordance with AIA Documents G702 and G703.

E. Initial values will be recognized to be an accurate accounting of the value of the work. Upon request by the Architect, support values given with data that will substantiate their correctness.

F. Identify quantities of designated materials or materials stored on which payment is expected to be made.

G. Use monthly submissions of Schedule of Values only as basis for Contractor's Application for Payment.

1.6 PREPARING SCHEDULE OF VALUES

A. General Procedures:

1. Prepare Preliminary Schedule of Values for review by Architect, Owner and Owner's Project Manager.
2. Incorporate requested modifications to produce a Final Schedule of Values, which will become the basis for documenting the progress of the Work with each Application for Payment.
3. Update Final Schedule of Values as necessary to reflect changes in the Work.

B. Itemize separate line item cost for each of the general cost items as specified in this Section.

C. Breakdown installed costs into:

1. Delivered cost of product
2. Total installation cost, with overhead and profit.
3. Construction phase.
4. Note that the Owner is exempt from Sales and Use Tax for all materials incorporated into the Work.

D. For each line item which has installed value of more than $20,000.00 breakdown costs to list major products, components, or operations under each line.

E. Sum of costs of all items listed in schedule shall be equal to total Contract Sum.

F. Each item shown on an Application for Payment Schedule of Values shall also appear on the CPM Schedule.

1.7 line items for schedule of values

A. Work Covered in Division 1: Itemize separate line item cost for each of the following general cost items:

1. Builder's Risk Insurance
2. Performance and Payment Bonds for General Contractor and Filed Subcontractors.
3. Field engineering; photographic documentation.
4. Coordination; project management.
5. Preparation of schedule and periodic updates.

    a. If periodic updates of schedule are not performed in a timely manner, the amount shown on the Schedule of Values for this line item shall be forfeit.

6. Weather protection; temporary fence.
7. Temporary heat, water, power and lighting.
8. Temporary office facilities; temporary sanitary facilities.
9. Construction aids, including staging, scaffolding, shoring.
10. Project sign.
11. Indoor air quality provisions.
12. Construction waste management.
13. Cutting and patching; selective demolition
14. Final cleaning.
15. Punchlist preparation and response.
16. Maintenance of as-built documents for architectural and site work; preparation of closeout documents.
17. Commissioning activities.

18. Overhead.
19. Other items of work as requested by the Architect or Owner.

B. Work Covered in Divisions 2 through 50: Provide at least one separate line item for each Section of the Specifications. Section line items shall be further subdivided into separate line items as follows:

1. Subdivide each line item into separate line items for individual floors of the project where applicable.
2. Identify material costs separately from labor costs.
3. Provide separate line items for the following where applicable:

    a. Submittals
    b. Maintenance of as-built documents for mechanical and electrical work
    c. Preparation of closeout documents
    d. Operations and Maintenance Manuals;
    e. Training
    f. Other items of work as requested by the Architect or Owner.

4. For mechanical and electrical work, provide the following additional separate line items where applicable:

    a. Commissioning activities other than demonstration of FPT to the Commissioning Firm
    b. Commissioning activities associated with demonstration of FPT to the Commissioning Firm

5. For each line item which has installed value of more than $20,000.00 break down costs to list major products, components, or operations under each line.

PART 2 - PRODUCTS [NOT USED]

PART 3 - EXECUTION [NOT USED]

END OF SECTION

SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. Responsibility for coordination of the Work.
2. Surveying and engineering.
3. Coordination Drawings.

B. Related work includes, but is not limited to, the following work under other Sections:

1. Survey information available to bidders: Section 003100 – AVAILABLE PROJECT INFORMATION.
2. General requirements for submittals: Section 013300 – SUBMITTAL PROCEDURES.

1.3 SUBMITTALS

A. Prepare and submit documentation in accordance with Section 013300 – SUBMITTAL PROCEDURES.

B. Drawings:

1. Survey of existing project conditions: Submit a set of reproducible drawings and certificate signed by registered engineer or land surveyor, certifying that elevations and locations of improvements are in conformance, or non-conformance with Contract Documents.
2. Survey of base plate elevations and anchor bolt locations.
3. Survey of as-built conditions: Certified survey showing all as-built dimensions, locations, angles and elevations of construction, to be submitted at Substantial Completion of the Work.
4. Coordination Drawings as described in this Section.

C. Certifications required for Work described in this Section:

1. Field Engineering: Submit name and address of surveyor and professional engineer to Architect.

1.4 COORDINATION

A. General: The Contractor shall be responsible for the proper fitting of all work and the coordination of the operations of all trades, Subcontractors, material installers and equipment engaged upon the Work. He shall perform or cause Subcontractors to perform all cutting, fitting, adjusting and patching necessary to make the several parts of the Work come together properly and to fit the Work to receive or be received by that of other contractors.

B. Project Supervision: The Contractor shall give his personal supervision to the Work and shall assign the following site staff for the Project:

1. Full-time Superintendent: A superintendent licensed in the Commonwealth of Massachusetts, with the authority to act on behalf of the Contractor. The Superintendent shall supervise the Work at all times throughout the duration of the Project.
2. Quality Control Monitor: A member of Contractor’s full-time on-site staff assigned to monitor the quality of the Work. The Quality Control Monitor may also be assigned to oversee and document construction waste removal.
3. The Contractor shall also provide an adequate staff for the proper coordination and expediting of the Work.

C. Coordination with Subcontractors: The Contractor shall be in charge of the entire Work and shall be responsible for the prompt coordination of all trades, including his own forces and his various Subcontractors, as well as the Owner's separate contractors, if they are on the job during the Contractor's operations, and shall become fully familiar with all work required under the Contract.

1. The above notwithstanding, each Subcontractor shall assume responsibility for the correctness and adequacy of his work. Each Subcontractor shall be responsible for and pay for all damage done by his work and his workers.
2. No Subcontractor shall be permitted on the site without the Superintendent present to supervise the Work.

D. Care shall be given to the proper scheduling, delivery, and installation of items to be built into rough construction which will affect the latter portions of the Work, such as anchors, pipe sleeves, inserts, conduit, pipes, lugs, clips, brackets, braces, hangers, bolts, miscellaneous metal, and similar items. These items are not necessarily specified under the trade Section under which they are to be installed. The Contractor shall ascertain that all are properly installed in their correct locations at the proper time, so as to prevent cutting and patching of finished work.

E. The Contractor shall be fully responsible for coordination of general construction work with that of Subcontractors for PLUMBING, ELECTRICAL, HEATING AND VENTILATING and all other specialized trades. He shall investigate, together with the Subcontractors involved, the routing of pipe, ductwork, and conduit with particular attention to interference of structural members, other pipes, ducts, and conduit cuts, headroom conditions, door and window openings and swings, pipe chases, and similar features of the building which may affect installation and proper functioning of such items.

F. Changes in design locations which may be necessary in the routing of pipes and ducts, or in the location of any mechanical, electrical or other equipment or in the location of other building elements, shall be anticipated and made prior to installation. Additional compensation will not be allowed for costs incurred as a result of the Contractor's failure to anticipate the necessity for such changes.

G. There shall be no change or variation in ceiling height, wall layout, shaft, chase, furring or other dimensions shown on Drawings without the specific written approval of the Architect.

H. The Contractor's responsibility for the coordination of all work under the Contract shall be complete, and shall extend to all modifications in the Work, whether or not such modifications entail a change in the Contract Price. Where the Contract Documents allow an optional material or method of performing a portion of the Work, or where the Contractor is ultimately allowed or directed to perform a part of the Work using a substitute material or method, the Contractor shall provide all other coordination and additional work that such change necessitates, without any additional cost to the Owner.

1.5 SURVEYING AND ENGINEERING, GENERAL

A. The Contractor shall employ a project engineer who is a qualified land surveyor registered to practice in the Commonwealth of Massachusetts, who shall establish and maintain grades and levels and permanent benchmarks. In addition, the Contractor shall designate one person from within his organization, with engineering experience, who shall do the usual engineering work required, including leveling, checking, and verifying wall and partition lines, elevations, etc.

B. Prior to commencement of any excavation or filling work on the site, the project engineer shall check locations of all structures and other fixed items with regard to property lines and other existing conditions. The Contractor shall be fully responsible for reporting to the Architect discrepancies between the dimensions and/or locations indicated on the Contract Drawings and those as they actually exist on the site.

C. After verification of all dimensions and locations, the Contractor shall submit to the Architect such verification in written form bearing the professional stamp of the surveyor. Failure to do so shall mean that the Contractor assumes responsibility for all corrective measures required at no addition to the Contract amount.

D. The Contractor shall lay out the Work and shall be responsible for all lines, elevations, and measurements of the building, grading, paving and other work under the Contract. He shall exercise proper precaution to verify the dimensions shown on the Drawings before laying out the Work and will be held responsible for any error resulting from his failure to exercise such precaution.

1.6 FIELD ENGINEERING REQUIREMENTS

A. General: Provide professional field engineering services, establish grades, lines and levels, by use of recognized engineering survey practices.

1. The Contractor’s attention is directed to the fact that Drawings have been prepared based on the assumption that all existing walls are set in orthogonal relationship to each other. The Contractor will be responsible for verifying the precise angle between existing walls, and bring to the attention of the Architect any conditions that deviate from orthogonal.
2. Submit surveys and documentation as described herein.

B. Scope of Field Engineering:

1. Architectural features in the existing construction for which precise vertical and horizontal reference points are required include, but are not limited to, the following:

a. Top of foundation wall.

b. Windowsill heights at each floor level.
c. Top of decorative masonry cornice and existing roof edge at perimeter of building.
d. Horizontal layout of existing masonry openings in all exterior walls.
e. All other reference points shown on Drawings.

2. Site features:

a. Existing grades, including grades immediately adjacent to existing building.

3. Structural elements: For each column, a precise base plate elevation and horizontal location shall be established. After the anchor bolts have been set in the foundations and leveling plates have been set in grout, the top surface of each leveling plate shall be surveyed to determine the following locations. Submit survey data to the Architect for review and approval prior to fabrication of structural steel.

a. Elevation of top surface of each leveling plate.
b. Precise position of the center of each anchor bolt in each leveling plate.

C. Qualifications of Surveyor or engineer: Qualified engineer or registered land surveyor, acceptable to Architect and the Owner.

1. Registered professional engineer of the discipline required for the specific service on the Project, licensed in the Commonwealth of Massachusetts.

D. Survey Reference Points:

1. Datum: Location of control datum to be used as reference point for horizontal and vertical survey measurements is shown on Drawings.
2. Locate and protect control and reference points prior to starting site work, and preserve all permanent reference points during construction.

a. Make no changes or relocations of control points without prior written notice to Architect.

3. In the event that any reference point is lost or destroyed, or requires relocation due to necessary changes in grades or construction, perform the following actions without delay:

a. Report change to Architect immediately.
b. Replacement of reference point shall be performed by surveyor, as directed by Architect.

4. Project Survey Requirements:

a. Establish a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.
b. Establish lines and levels, locate and lay out by instrumentation and other appropriate means.
c. Verify layouts periodically using the same means as those by which they were established.

E. Records:

1. Maintain a complete, accurate log of all control and survey work as it progresses.

2. Prepare and submit a survey of existing conditions and a final survey of as-built conditions containing all relevant horizontal and vertical dimensions and reference point data.

1.7 COORDINATION DRAWINGS

A. The Contractor shall be responsible for the coordination of all mechanical and electrical work with architectural requirements including ceiling layouts. Well in advance of commencing work in any area and before materials are fabricated or work begun, he shall submit to the Architect complete Coordination Drawings in the form of reproducible transparencies in 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”.

B. 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.

C. Prepare Coordination Drawings as follows:

1. The background for coordination drawings shall show the reflected ceiling plan.
2. Contractor shall require HEATING AND VENTILATING Subcontractor to prepare original Drawings showing all ductwork, hot water and other heating lines, based on approved Sheet Metal Fabrication Drawings and related mechanical submittals.
3. Contractor shall have transparencies made there from, and shall distribute them to the Architect and the Plumbing Subcontractor for the next step.
4. Contractor shall then require PLUMBING Subcontractor to indicate all his equipment and plumbing lines on these transparencies.
5. Contractor shall then require FIRE PROTECTION Subcontractor to indicate his equipment and piping on these transparencies.
6. Contractor shall require the ELECTRICAL Subcontractor to indicate his equipment and conduit lines on the same Drawings.
7. Contractor shall resolve conflicts and then submit these transparencies to the Architect for review.
8. Submit complete final set of coordination drawings for record purposes.

D. Coordination Drawings shall bear the signature of all subcontractors involved indicating 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". Drawings without these notations, or Drawings submitted more than 120 days after the execution of the Contract, will not be accepted or reviewed by the Architect.

E. If any space conflicts cannot be resolved by the Contractor, he shall immediately notify the Architect.

F. Coordination Drawings are for the Contractor's and Architect'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.

G. Architect's review of Coordination Drawings shall not relieve General Contractor from his overall responsibility for coordination of all work performed pursuant to the Contract or from any other requirements of the Contract.

H. Access panel coordination: Show locations and sizes of all access panels for all trades on Coordination Drawings.

PART 2 - PRODUCTS [NOT USED]

PART 3 - EXECUTION [NOT USED]

END OF SECTION

SECTION 013119

PROJECT MEETINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. Organizational meetings.
2. Project meetings.
3. Pre-Installation conferences
4. Post-construction meetings

B. Related work includes, but is not limited to, the following work under other Sections:

1. Requirements for construction schedules: Section 013200 Construction Progress Documentation.

PART 2 - PRODUCTS

2.1 ORGANIZATIONAL MEETINGS

A. General: The Owner’s Project Manager will schedule pre-construction organizational meetings, periodic Project meetings, specially called meetings throughout the progress of the Work, and post-construction meetings. Representatives of the Contractor shall attend all such meeting. Subcontractors shall attend as indicated below and as requested by the Architect or the Owner’s Project Manager.

B. Pre-Construction Meeting: Immediately following award of Contract, the Architect will call one or more preliminary organizational meetings, during which detailed procedures will be worked out for submission and review of Shop Drawings and samples, format and extent of the Progress Schedule and Schedule of Values, format and methods for progress payment requisitions, channels of communication between Owner, the Owner’s Project Manager, Architect's and Contractor's personnel, and other routines to be followed during construction. The Architect will then issue a directive summarizing such procedures.

C. Exterior Envelope Meeting: Attendance by Architect, Contractor, major subcontractors. Agenda shall include as applicable: Review of exterior wall details, wall construction, sample panel preparation, cleaning, control and expansion joints, cold weather procedures.

D. Roofing/Flashings Meeting: Attendance by Architect, Contractor, roofing subcontractor, and representative of roofing manufacturer. Agenda shall include as applicable: Preparation of roof

decks, flashing and blocking details, roofing procedures and inspections, bonds and guarantees, weather conditions during roofing, protection of roof membrane during construction.

E. Interior Finishes Meeting: Attendance by Architect, Contractor, major subcontractors. Agenda shall include as applicable: Quality of workmanship, environmental conditions for application of finishes, drywall details, millwork details, condition of surfaces to receive finishes, tile work, painting work, samples and test areas and approvals, coordination with mechanical and electrical interfaces and penetrations, indoor air quality.

2.2 PROJECT MEETINGS

A. The Architect shall schedule and meet regularly with the Owner, the Owner's Project Manager and the Contractor at the site of the Work during the course of the Contract for the purpose of progress review, coordination of Shop Drawing schedules, sample submittals, and other items of work requiring such coordination. The dates of such meetings shall be as mutually agreed upon between the Owner, the Owner's Project Manager, Contractor and the Architect. Contractor shall require Subcontractors to attend such meetings if requested by the Architect.

B. The Contractor shall take minutes of such meetings and shall distribute copies of the minutes to all concerned.

C. Contractor's and Subcontractor's representatives attending such meetings shall include the job superintendent or other responsible party approved by the Architect. Such representatives shall be empowered to make, at these meetings, definite decisions binding upon their respective employers regarding all matters pertaining to work under this Contract.

D. The Contractor shall furnish the Owner, the Owner's Project Manager and the Architect, in writing, the names, addresses, and telephone numbers of Contractor's and principal Subcontractors' personnel to be contacted in the event of an out-of-hours emergency at the building site. He shall also maintain a similar list readily visible from the outside of the field office.

2.3 PREINSTALLATION CONFERENCES

A. Pre-Installation Conferences: Conduct pre-installation conferences at site prior to construction activities that require coordination.

1. Schedule the conference to occur after submittals have been approved for the materials or systems.
2. Installers, manufacturer's representatives, and fabricators of materials or systems affected shall be required to attend. Advise Designer of scheduled meeting dates.
3. Do not allow affected work to proceed if the conference cannot be successfully concluded. Initiate actions necessary to resolve impediments to performance of the work and reconvene the conference at the earliest feasible date.

B. Work for which pre-installation conferences will be required include the following. Additional pre-installation conferences may be required by specifications in Sections 2 through 50, and by the Owner or Architect during the progress of the Work:

1. Air barrier system.
2. Roofing.

C. Refer to individual specifications sections for additional requirements.

2.4 POST-CONSTRUCTION MEETINGS

A. Not less often than every three months, starting with the date of Substantial Completion and continuing for one year thereafter, representatives of the Contractor and the Subcontractors for FIRE PROTECTION, PLUMBING, HVAC, and ELECTRICAL Work shall meet with the Architect and Owner's Project Manager at the site in accordance with an agreed-upon schedule in order to inspect the Work and to plan correction of any deficiencies or failures discovered during this period.

B. Representatives of the Contractor and Subcontractors attending such meetings shall be the same persons, or shall have the same powers and authority, as those attending job meetings prior to the date of Substantial Completion.

C. Post-Warranty Meeting: Refer to Section 018100 - COMMISSIONING, for meeting to be held with Commissioning Agent.

END OF SECTION

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. Time for Completion and Liquidated Damages.
2. Sequencing requirements.
3. Phasing requirements.
4. Requirements for scheduling closeout activities.
5. Critical Path Method Schedule preparation and submission.
6. Photographic documentation of construction.

B. Related work includes, but is not limited to, the following work under other Sections:

1. Section 011400 – WORK RESTRICTIONS: Hours of work and related scheduling criteria.
2. Section 012400 – SCHEDULE OF VALUES: Allocation of portions of the Work as line items in applications for payment.
3. Section 013100 – PROJECT MANAGEMENT AND COORDINATION: Contractor responsibility for coordinating the Work.
4. Section 013119 – PROJECT MEETINGS: Scheduling construction-related meetings.
5. Section 013300 – SUBMITTAL PROCEDURES: Coordination of submittal schedule with construction.
6. Section 014000 – QUALITY REQUIREMENTS: Special sequencing requirements required for inspection of building components prior to concealment.
7. Section 017700 – CLOSEOUT PROCEDURES: Requirements for Substantial Completion and Final Completion.

1.3 SUBMITTALS

A. Preliminary Construction Schedule: Within 10 calendar days following receipt of the Notice to Proceed, submit a CD containing an electronic copy (PRX) and two paper copies for review by the Owner, Project Manager and the Architect. This preliminary schedule shall include the project contract dates, milestones, long lead items, major work activities and a critical path to completion. (approximately 100 to 150 schedule activities)

1. Acceptance of the Preliminary Construction Schedule by the Owner, Project Manager and Architect shall be a prerequisite to certification of the first Application for Payment.

B. Complete and Detailed Construction Schedule: Within 45 calendar days following receipt of the Notice to Proceed, and at least 15 calendar days prior to submitting the second Application for

Payment, submit a CD containing an electronic copy(PRX) and two paper copies of the complete and detailed schedule, to show entire schedule for entire construction period.

1. Acceptance of the Complete and Detailed Construction Schedule by the Owner, Project Manager and Architect shall be a prerequisite to certification of the second Application for Payment.

C. Monthly Schedule Update: With each monthly Application for Payment, submit a schedule update of the accepted Complete and Detailed Construction Schedule accompanied by a written narrative reporting on the progress of the Work and a CD containing an electronic copy(PRX) and two paper copies of the Monthly Schedule Update.

1. Acceptance of the Updated Schedule each month by the Owner, Project Manager and Architect shall be a prerequisite to certification of the monthly Application for Payment.

D. Daily Construction Field Reports: Submit two copies of the current week's field reports to the Owner's Project Manager and the Architect at the end of each week. (Electronic submission is acceptable)

E. Special Reports: Submit two copies of special reports of unusual events at the site directly to Owner’s Project Manager and a copy to the Architect, on the day of the occurrence. Distribute additional copies of report to parties affected by the occurrence.

F. Construction Photographs: Submit construction photographs as specified herein.

1.4 TIME FOR COMPLETION AND LIQUIDATED DAMAGES

A. It is understood and mutually agreed, by and between the Contractor and the Owner, that the date of beginning and the time for completion for each phase are essential conditions of this Contract, and it is further mutually understood and agreed that the Work embraced in this Contract shall be commenced by the date specified therein.

B. The Contractor agrees that said Work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Owner, that the time for the completion of the Work in each phase described herein is a reasonable time for the completion of the same, taking into consideration the usual industrial and climatic conditions prevailing in this locality.

C. It is further agreed that time is of the essence of each and every portion of the Contract and of the Contract Documents wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new limit fixed by such extension shall be of the essence of this Contract. Provided, that the Contractor shall not be charged with liquidated damages for any excess cost when the delay in completion of the Work is due:

1. To any preference, priority, or allocation order duly issued by the Government;
2. To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including, but not restricted to: Acts of God, or of the public enemy; acts of the Owner; acts of another Contractor in the performance of a Contract with the Owner; fires, floods, epidemics, quarantine restrictions, strikes, and freight embargoes.
3. To any delays of Subcontractors or suppliers occasioned by any of the clauses specified in subparagraphs 1. and 2. of this Paragraph.

D. Provided, further, that the Contractor shall, within ten (10) days from the beginning of such delay, unless the Owner shall grant a further period of time prior to the date of final settlement of the Contract, notify the Owner, in writing, of the causes of the delay, who shall ascertain the facts and extent of the delay and notify the Contractor within a reasonable time of its decision in the matter.

E. If the Contractor shall neglect, fail or refuse to substantially complete the Work within the time herein specified or any proper extension thereof granted by the Owner, the Contractor does hereby agree, as part of the consideration for the awarding of this Contract, to pay to the Owner the amount specified in the Agreement, not as a penalty but as liquidated damages for such breach of contract as herein set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the Contract for completing the Work.

F. The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be retained from time to time by the Owner from current periodic estimates. This remedy to the Owner shall be cumulative to the remedies available to the Owner under law.

G. Work Executed after Substantial Completion: The Architect will continue to execute their administrative responsibilities for the Contract, as provided in the General Conditions, beyond the specified date of Final Completion.

1. If, due to delays on the Contractor's part in the completion of the Work, the Architect is required to continue in this role beyond the specified date for Final Completion, the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to perform additional administration duties, until the Work is complete.
2. Refer to Section 011400 – Work Restrictions, for procedures required in cases where Contractor is responsible to the Owner for costs for Additional Services of the Architect.

H. Liquidated Damages: Refer to INSTRUCTIONS TO BIDDERS, for provisions for, and amounts of, Liquidated Damages.

1.5 SEQUENCING REQUIREMENTS

A. Exterior Envelope Construction and Inspection: Schedule the installation of materials comprising the exterior walls and roofs to minimize exposure of construction materials to damage by ultraviolet light, wind and weather. Notify the Architect prior to concealment of air barrier, to permit inspection and testing. Refer to Section 014000 – QUALITY REQUIREMENTS, and individual technical specification sections for specific requirements.

B. Indoor Air Quality Provisions: Refer to Section 018119 – INDOOR AIR QUALITY REQUIREMENTS, for the following activities that will have an impact on scheduling:

1. Sequencing required to minimize adsorption of airborne contaminants on new surfaces.
2. Sequence of building flush-out with respect to completion, testing and balancing of mechanical systems.

C. Commissioning: Refer to the Commissioning Section, for inspections, testing and related activities to be performed by Commissioning Agent during and after construction.

1.6 SCHEDULING REQUIREMENTS FOR CLOSEOUT

A. General: Closeout scheduling shall be carefully coordinated with activities required for Commissioning and the approved Indoor Air Quality Management Plan. The following sequence of activities is a summary of requirements of many trades. Refer to other Division 1 Sections and Technical Sections for additional information as indicated.

1. The Contractor's attention is brought to the fact that no HVAC system shall be started up before the completion of all major finishes, casework installation and final cleanup.

B. Initial Closeout Activities:

1. Commissioning Coordination Meeting: Schedule meeting well in advance of anticipated date for start-up of mechanical and electrical systems. At this meeting, the Commissioning Firm will distribute Pre-Functional Performance Test (PFPT) checklists, and scheduling requirements will be reviewed. Refer to Section 013119 – PROJECT MEETINGS.
2. Confirmation of Completion of Finishes, Casework and Cleaning: The Contractor submit a letter confirming that all major finishes have been applied, all casework is installed and final cleanup has been completed.

C. System Start-Up, Building Flush-out and Testing and Balancing.

1. The HVAC system shall be started up with new filters as specified in Section 230000 – Heating, Ventilating and Air Conditioning.
2. Building Flush-Out: As part of the Indoor Air Quality Plan, the HVAC system shall be run for 28 calendar days with 100 percent fresh air. Disable carbon dioxide sensors during this time. Refer to Section 230000 – Heating, Ventilating and Air Conditioning for additional requirements for system operation.
3. Testing and Balancing: After the building flush-out is complete, replace HVAC system filters, adjust HVAC system for normal operation and conduct tests for balancing the system.

D. Substantial Completion: When system start-up and the related activities specified above have been completed on all mechanical and electrical systems, notify the Architect that the Project is Substantially Complete. Refer to Section 017700 – PROJECT CLOSEOUT, for additional requirements for Substantial Completion.

PART 2 - PRODUCTS

2.1 CRITICAL PATH METHOD SCHEDULE (CPM) GENERAL

A. The purpose of the Construction Schedule shall be to:

1. Assure adequate planning, scheduling and reporting during execution of the work by the Contractor;
2. Assist the Contractor, Architect, Project Manager and Owner in monitoring the progress of the work and evaluating proposed changes to the Contract and the Construction schedule;
3. Assist the Owner, Project Manager, Architect and the Contractor in the preparation and evaluation of the Contractor's monthly progress payments.

B. The Construction Schedules shall employ the Critical Path Method (CPM) for the planning, scheduling and reporting of the work to be performed under the contract and shall meet the following requirements:

1. The schedule shall be produced utilizing the most current version of Primavera Project Planner software system or equivalent and the data fully transferable to Primavera Project Planner.
2. The type of schedule shall be time scaled Precedence Diagramming Method (PDM) with Finish to Start with zero (0) lag dependency relationship.
3. Activity duration shall be in units of whole working days and shall be limited to a minimum of one (1) and a maximum of twenty (20) working days for each activity.
4. The schedules and the corresponding completion dates shall meet the contract duration (remaining contract duration for the monthly updates) of the project. Failure by the Contractor to include any element of work required for performance of the Contract shall not excuse the General Contractor from completing all work within the Contract Time. Under no circumstances, shall the Contractor be entitled to an equitable adjustment in the event of failing to achieve an early completion schedule.
5. The Contractor shall review the planned activity coding and activity ID format with the Project Manager prior to the development of the Detailed Construction Schedule. At a minimum, the Project Manager will require the following coding: Area, Location/Phase/Shift, Work Type/Trade, CSI Code, and a separate code for each subcontractor.
6. Proposed durations assigned to each activity shall be the Contractor's best estimate of time required to complete the activity considering the scope and resources planned for the activity, utilizing the appropriate workday calendar.
7. Seasonal weather conditions shall be considered and included in the planning and scheduling of all work influenced by high or low ambient temperatures and/or precipitation to ensure completion of all work within the Contract time. Seasonal weather conditions shall be determined by an assessment of average historical climatic conditions based upon the preceding ten (10) year records published for the locality by the National Ocean and Atmospheric Administration (NOAA).
8. The OPM’s acceptance of the Construction Schedule shall not relieve the Contractor of responsibility for timing, planning and scheduling of the Work, nor impose any duty on the Architect or Owner with respect to the timing, planning or scheduling of the Work.

2.2 PRELIMINARY CONSTRUCTION SCHEDULE

A. Within 10 calendar days following receipt of Notice to Proceed, prepare and submit for review prints and CD of the Preliminary Construction CPM Schedule covering the first 90 days of construction. The schedule shall be neatly organized and plotted, time-scaled from left to right on standard size sheets. The Preliminary Construction Schedule shall cover the following phases and/or activities:

1. Proposed mobilization, procurement and planned construction within the first 90 days after Notice To Proceed.
2. Include a summary bar for major areas of the remainder of the Work and a cash requirement prediction based on indicated activities.

B. The Preliminary Schedule shall be incorporated into the Complete and Detailed Schedule including all revisions directed by the Owner, Project Manager and Architect.

2.3 COMPLETE AND DETAILED CONSTRUCTION SCHEDULE

A. Prepare and submit a comprehensive, fully developed Complete and Detailed CPM Construction Schedule within 45 days after Notice to Proceed and at least 15 days prior to the second Monthly application.

1. The Complete and Detailed schedule shall incorporate the accepted Preliminary Construction Schedule with the Owner/Project Manager/Architect's comments
2. Schedule shall be neatly organized and plotted time scaled from left to right on Project standard size sheets with suitable notation relating the interface points among sheets.
3. The General Contractor's Schedule shall consist of, but not be limited to, the following:

    a. Proposed procurement, submittal preparation, submittal review, fabrication & delivery, construction, testing, commissioning, and permitting activities.
    b. Proposed durations for activities.
    c. Proposed sequencing of activities (predecessors & successors).
    d. Milestone events as required by the Contract Documents and Division 1 of the Specifications.

4. The following shall be depicted on the Schedule for each activity:

    a. Concise description of the work represented by the activity (maximum forty-eight (48) characters). The work related to each activity shall be limited to one work trade and one area. All descriptions shall include area designations.
    b. In developing the Schedule, the Contractor shall be responsible for assuring that subcontractor and supplier work at all tiers, as well as its own work, is included in the Schedule.
    c. The Schedule as developed shall show the sequence and interdependence of activities required for complete performance of the work. The Contractor shall be responsible for assuring that all work sequences are logical and the Schedule shows a coordinated plan of the work.
    d. Each activity shall have only one responsible party and will be coded accordingly.

5. For the purposes of utilizing schedule targets, activity id's shall not be modified.
6. The schedule shall employ retained logic.
7. Any float suppression techniques identified shall be corrected by the Contractor.
8. The Contractor shall utilize logic, durations, and appropriate calendar assignment to forecast dates, not activity constraints.

2.4 MONTHLY SCHEDULE UPDATE REPORTS

A. Monthly Schedule Update Report: Evaluate the status of the work as of the 25th of each month to show actual progress and to identify problem areas. Update the Complete and Detailed Construction schedule and print a schedule summary. Include approved Change Orders and Construction Change Directives within the updated schedule

B. The Contractor shall furnish sufficient forces, offices, facilities and equipment at no additional cost to the Owner, and shall work such hours as necessary, within any local restrictions or agreements incorporated into the Contract, to ensure the prosecution of the work in accordance with the current monthly Project Schedule Update. Should the monthly update show that the Contractor is fourteen (14) or more workdays behind schedule, the Contractor shall prepare a Recovery Schedule at no additional cost to the Owner explaining and displaying how the General Contractor intends to reschedule the work in order to regain compliance with the contract. The provision of this paragraph may include the Contractor increasing the hours of work, the number of shifts, overtime operations and/or the amount of construction plant and

equipment or working on Saturdays, Sundays and holidays, within agreed working hours or variance granted, provided the General Contractor gives reasonable notice to the Owner.

2.5 RECOVERY SCHEDULE

A. When directed by the Project Manager/Architect, the Contractor shall develop a Recovery Schedule with a detailed narrative for all the remaining work based on the last accepted Monthly Schedule Update. The Recovery Schedule shall represent the Contractors current work sequence plan and shall forecast completion of the remaining work within remaining contract durations. The Recovery Schedule narrative shall enumerate the Contractor's work plan including increases to crew sizes and/or extended shifts to complete work with in remaining contract durations. The Recovery Schedule shall conform to requirements set forth in Paragraph 1.04 (Complete and Detailed Construction Schedule).

B. The Contractor shall be responsible to develop mitigation measures for all delays, regardless of the responsibility for the delays, and to identify all time and cost impacts to the work associated with those mitigation measures. Whenever it is possible for the Contractor to mitigate delay without added cost, the Contractor shall do so. The Contractor shall mitigate all delays as efficiently and economically as possible, with the objective of minimizing both the time and cost impact of the delay, regardless of the responsibility of the delay.

C. Unless circumstances otherwise require, the Contractor shall not pursue mitigation action for which it expects the Owner/Architect to be liable, prior to notifying the Owner/Architect and receiving Owner/Architect authorization to proceed with the mitigation action. Any action taken by the Contractor prior to receiving approval from the Owner/Architect shall be at the Contractor's risk.

2.6 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report, recording events at the site. Report the following information, as applicable.

1. List of subcontractors at the site, and approximate count of personnel.
2. High and low temperatures, general weather conditions (when exterior work is in progress)
3. Meetings and significant decisions.
4. Accidents, unusual events, and emergency procedures.
5. Stoppages, delays, shortages, losses.
6. Meter readings and similar recordings.
7. Services connected, disconnected.
8. Orders and requests of governing authorities.
9. Change Orders received, implemented.
10. Equipment or system tests and start-ups.
11. Partial Completions, occupancies.
12. Substantial Completions authorized.

B. At the end of each week, compile the daily reports for the preceding week. Have the Contractor's Superintendent sign the daily reports and prepare a brief outline of the Work anticipated for the coming work week. Submit 1 copy to the Owner/Owner's Project Manager and place 1 copy in the Project Record Documents file.

2.7 CONSTRUCTION PHOTOGRAPHS

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

B. Photographer: Engage a qualified photographer to take construction photographs.

C. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

D. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.
2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect and Owner.

E. Preconstruction Photographs: Before commencement of demolition take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

1. Flag construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

F. Periodic Construction Photographs: Take a minimum of 20 photographs weekly, with timing each month adjusted to coincide monthly with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

G. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect and Owner will inform photographer of desired vantage points.

PART 3 - EXECUTION

3.1 SCHEDULING THE WORK

A. The Contractor shall perform the Work in accordance with the approved CPM Schedule.

1. If during the progress of the job the Contractor misses a start date of an activity on the critical path, the Contractor shall, within five (5) working days, advise the Architect in writing of action proposed to bring the Work up to schedule, and shall submit a revised CPM Schedule indicating such action, together with a typed list of such revisions.
2. If the Contractor fails to submit a revised schedule within the specified time or if the Architect is not convinced of the efficacy of the measures proposed, the Owner may, at its option, require the Contractor to accelerate the progress of the Work, without additional cost to the Owner, by increasing the work force or the hours of work, or by other reasonable means approved by the Architect.

END OF SECTION

SECTION 013300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. Submittal schedule
2. Product data
3. Shop drawings
4. Samples
5. Colors and finishes
6. Calculations
7. Informational submittals
8. Action on submittals.
9. Substitution requests.

B. Related work includes, but is not limited to, the following work under other Sections:

1. Availability and restrictions for use of electronic copies of Contract Document: Section 011400 – Work Restrictions.
2. Specific requirements for submittal of construction schedules: Section 013200 Construction Progress Documentation.
3. Specific requirements for submittal of schedule of values: Section 012400 – Schedule of Values.
4. Requirements for submittal of coordination drawings: Section 013100 – Project Management and Coordination.
5. Submittal of final record drawings and other documents: Section 017839 – Project Record Documents.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action. Action submittals include product date, shop drawings and samples.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals include calculations and other informational submittals described in this Section.

C. Substitutions: Changes in products, materials, equipment and methods of construction from those required by the Contract Documents, as proposed by the Contractor and not considered “or equal”. Refer to definition of “or equal” in Section 011100 – Summary of Work.

1.4 SUBMITTALS

A. Submittal Schedule:

1. Within 21 calendar days after signing the Agreement, prepare and submit for the Architect's approval a schedule of Shop Drawings, Product Data and Samples required to be submitted for the Work.

    a. The schedule shall indicate by trade the date by which final approval of each item must be obtained and shall be revised as required by conditions of work, subject to the Architect's approval.
    b. The schedule shall be derived from the Contractor’s CPM Schedule.

2. The Architect's review, including Consultant's review period, will not exceed 21 working days (excluding weekends & holidays) from the date on which the Architect receives the submission. Contractor shall strictly adhere to the established dates set forth by the Schedule of Submittals specified above in paragraph 2.01 A.
3. Each submittal shall be made no later than 60 days prior to the time for incorporation of the item into the Work, or earlier under the following conditions:

    a. As required to furnish and deliver to the site the specific item or items required, with sufficient time to allow proper examination and review of such submittals.
    b. If the item in question is to be incorporated in the work prior to the expiration of 60 calendar days from the time of execution of the Contract, the aforesaid written notice shall be submitted to the Architect immediately following the execution of the Contract.
    c. Substitutions: Each request for a substitution shall be made no later than 90 days prior to the time for incorporation of the item into the Work.

4. No item, material, article, system or piece of equipment requiring approval of the Architect shall be ordered or installed until such approval has been obtained.
5. Contractor shall provide the Owner’s Project Manager and Clerk of the Works with software and training for programs used to schedule, and track Shop Drawings, Samples, and RFI’s.

B. Product List for Color Selection: To facilitate the preparation of the color schedule, the Contractor shall submit, within forty-five (45) calendar days following date of Award of Contract, unless otherwise extended by the Architect, a list of the names of the manufacturers whose products he proposes to use.

1. List products for which color, finish, pattern, texture, or other related information is a consideration, including, but not limited to the following:

    a. Exterior materials: Face brick; exterior concrete masonry units; factory-finished metal siding; factory finish for doors, windows and louvers.
    b. Casework finishes: Solid and veneer wood with transparent finish; plastic laminate.
    c. Interior finishes: Ceramic tile, acoustical ceiling tile, resilient flooring, carpet, paint.
    d. Specialties available in a choice of colors: Toilet partitions; lockers; operable panel finishes.
    e. Other items for which the above properties affect the design.

2. Products listed shall be as specified unless substitution has been approved.

C. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use facsimile of form provided at end of Section.
2. Documentation: Show compliance with requirements for substitutions listed on the Substitution Request form, and additional requirements as may be requested by the Architect or as otherwise applicable.

D. Product Data, Shop Drawings, Samples, Schedules and other Submittals: Refer to individual Specification Sections for submittals required.

E. Confirmation of contract between Contractor and printing company for reproduction of shop drawings as specified in this Section.

PART 2 - PRODUCTS

2.1 SUBMITTAL PREPARATION, GENERAL

A. Preparation of Submittals: To receive consideration by the Architect, submittals shall be accompanied by a letter of transmittal. Each submittal shall contain the following information on the Drawing title block or a cover sheet stapled to the submittal:

1. Project identification
2. Architect's name
3. Date of preparation of submission, and of revision if applicable
4. Submittal number and title of item the Drawings refers to
5. Architect's Drawing numbers and Specification paragraph number used as a reference in preparing submittal
6. Contractor's and Subcontractor's names, & addresses and phone numbers
7. Name of person or firm preparing Drawings
8. Statement on stamp of approval by the Contractor, signifying that he has seen and examined the submittal and that requirements of the General Conditions have been complied with

B. Each submittal cover sheet shall contain a clear space approximately 80 square inches for stamps and Architect's comments. Each drawing shall contain a similar space as an additional border on the right or bottom.

C. Distribution:

1. Contractor shall electronically deliver submittals to the Architect and its consultants in a format acceptable to the Architect.
2. Simultaneously, Contractor shall deliver 1 hard copy print to the Architect and its consultants.
3. Architect and consultants will review submittals, and the Architect will post reviewed submittals on FTP site and/or email to Contractor.
4. Architect will hand deliver Owner Representative and Contractor hard copies at the weekly site meeting.
5. Contractor is responsible for distribution to all trades.

2.2 PRODUCT DATA

A. Manufacturers' Product Literature: For standard manufactured items, submit manufacturer's catalog sheets with illustrated cuts of the items to be furnished.

1. Include scale details, sizes, dimensions, performance characteristics, capacities and other pertinent information.
2. Each submittal of product data shall be accompanied by an appropriate transmittal form with specific reference to the applicable paragraph in the Specifications.
3. Indicate clearly on such printed matter which of several items is being submitted for approval.

B. If catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features that the Contractor proposes to furnish shall be clearly circled or otherwise indicated, and all irrelevant diagrams, notes, or other information deleted or canceled.

1. If any variations from the catalog description are proposed or required, such variations shall be clearly noted on the cut by the Contractor.
2. Wiring diagrams shall be produced to address specific project requirements. Catalog cuts of wiring diagrams will not be acceptable.

2.3 SHOP DRAWINGS

A. The Contractor shall prepare shop drawings showing such features as required by the Technical Specifications Sections, to demonstrate an understanding of the particular conditions unique to this Project.

1. Prepare shop drawings at a scale of at least twice the scale of contract drawings showing the same work.
2. Reproduction of Contract Documents in any form will not be accepted for use as Shop Drawings, unless specifically allowed in writing by the Architect for a particular portion of the Work.
3. Refer to Section 011400 –WORK RESTRICTIONS for permissible use of electronic documents for the purpose of preparation of shop drawings. Use of Project Electronic Files for shop drawing preparation will be subject to the requirements specified in that Section.

B. Shop Drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that such units may be checked individually and as an assembly.

C. Shop Drawing Distribution:

1. Shop Drawings shall be submitted through the Contractor directly to the applicable consultant and the Architect.
2. Drawings submitted directly from Subcontractors, manufacturers or vendors, or directly to the Architect's consultants, will be returned to the Contractor without action.
3. The Architect will forward copies of submittals to the Clerk of the Works when so requested for their use. However, it is the responsibility of only the Architect and their Consultants to review and respond to submittals.

D. Each drawing and print shall have a clear space approximately 80 square inches as an additional border on the right or bottom for stamps and Architect's comments.

E. Shop Drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work and/or adjacent materials.

F. If any information on previously submitted Shop Drawings, aside from notations made by the Architect is revised in any way, such revision shall be circled or otherwise graphically brought to the Architect's attention. If approved Drawings are subsequently revised, they shall be resubmitted to the Architect with all revisions clearly marked for the Architect's attention. Whenever drawings are revised, the latest revisions shall be circled or otherwise indicated to distinguish them clearly from all previous revisions (and from the information on the original drawing).

2.4 SAMPLES

A. Submit samples as required under the various Sections of the Specifications. Each sample shall be accompanied by a transmittal and cover sheet as required for all submittals.

B. Before submitting samples, consult with Architect to determine whether samples are to be submitted to Architect's office, field, or other location.

C. Samples shall be submitted in triplicate, unless otherwise specified or directed by the Architect.

D. Samples may be submitted to Architect directly from manufacturers, vendors, suppliers, Subcontractors, or others, but a separate transmittal letter shall be submitted through the Contractor in each such case.

E. Approved samples of major or expensive items or assemblies, if in good condition and meeting all requirements of the Contract, may be properly marked for identification and used in the Work, provided that all shipping and handling charges are paid by the Contractor.

F. Each sample shall have a label indicating the material represented, its place of origin, and the names of the producer, the Architect, the Contractor, the Subcontractor and the building or Work for which the material is intended. Samples shall be marked to indicate the Drawing numbers or Specification Paragraph requiring the materials represented.

G. Approval of samples for color, texture, and other aesthetic qualities shall not be construed as approval of other characteristics.

H. Approved samples, unless specifically stated by the Contractor as slated for incorporation in the Work, will be kept on file (and accessible for inspection) by the Architect until Final Acceptance of the Project. Any sample not reclaimed by the Contractor within thirty (30) days after Substantial Completion of the Project will be considered unclaimed material, and may be disposed of by the Architect.

2.5 COLORS AND FINISHES

A. The Architect will prepare a master color schedule indicating the required color, finish, pattern, material, texture, and other pertinent information in connection with interior and exterior finishes.

B. Color chips shall be submitted for all items having color unless otherwise directed or approved by the Architect. Upon the expiration of such 45-day period, the Architect will proceed with color selection and preparation of final color schedule. Printed reproductions of colors will not be accepted.

C. The Architect will select the colors and finishes of a manufacturer within the framework of the Specifications, for each item where the Contractor fails to submit the name of a specific manufacturer within the allotted time, and the Contractor shall provide such materials without additional compensation.

2.6 CALCULATIONS

A. Calculations Based on Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, submit calculations demonstrating that products and systems comply with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents.
2. Include list of codes, loads, and other factors used in performing these services

2.7 INFORMATIONAL SUBMITTALS

A. General: Informational submittals comprise written information that does not require Architect's responsive action. Submit to the Architect two copies, or more if specified, for each informational submittal. The Architect will distribute copies to the Owner for their records.

B. Informational submittals required for the Work include, but are not limited to, the following:

1. Storm Water Pollution Prevention Plan Documentation, as specified in Section 011400 – WORK RESTRICTIONS
2. Calculations for Contractor-engineered work, as specified in particular specification sections in Divisions 2 through 50.
3. Research/evaluation reports and test data as specified in particular specification sections in Divisions 2 through 50.
4. Certifications and other qualification data, as specified in particular specification sections in Divisions 2 through 50.
5. Maintenance data, as specified in particular specification sections in Divisions 2 through 50.
6. Confirmation of contract with printing company as specified in this Section.

PART 3 - EXECUTION

3.1 CONTRACTOR ACTION ON SUBMITTALS

A. Should the Architect in checking shop drawings or other submittals make changes which the Contractor deems will increase the Contract Price, the Contractor shall so inform the Architect in writing within fourteen (14) days following receipt of the checked submittals and prior to starting fabrication of the item or items. Failing this, the Contractor shall be deemed to have waived all claims for extra compensation for the work involved.

B. Notes or other information on submittals that are contrary to provisions of the Contract Documents shall be deemed to be addressed to the applicable Contractor, Subcontractor, material supplier or other parties involved, and shall have no force or effect with respect to this Contract, even though the Shop Drawing or Sample involved is approved by the Architect. In particular the terms "By Others", "N.I.C." or words of similar meaning and import on submissions shall not be deemed to imply that the referenced items are to be omitted from this Contract.

C. The Contractor shall obtain and distribute copies of approved Shop Drawings and other Submittals to his subcontractors and material suppliers needing such information, at no additional cost to the Owner.

D. The Contractor shall keep on the site, in good order, a complete up-to-date set of all approved Shop Drawings and other Submittals.

E. Contractor shall assume full liability for delay attributed to insufficient time for delivery and/or installation of material or performance of the Work when approval of pertinent Shop Drawings is withheld due to failure of the Contractor to submit, revise, or resubmit Shop Drawings in adequate time to allow the Architect reasonable time, not to exceed twenty-one (21) working days (excluding weekends & holidays), for normal checking and processing of each submission and resubmission. The Architect will not be limited to twenty-one (21) days when the Shop Drawing Schedule has not been submitted or is not current.

3.2 ARCHITECT ACTION ON SUBMITTALS

A. Product Data and Shop Drawings: After reviewing product data submittals, the Architect will mark each submittal with one of the following responses

1. The Architect will annotate the transparency or an original copy and apply a stamp including the following information: "Reviewed as required by the Construction Contract Documents and approved, but only for conformance to the design concept of the Work, and subject to further limitations and requirements contained in the Contract Documents."
2. "Rejected". Two copies of each rejected submittal will be returned to the Contractor. Rejected copies shall be resubmitted in the same manner until approval is obtained.
3. The stamp will also contain notes indicating possible actions, namely; "rejected"; "revise and resubmit"; and "furnish as corrected". Architect will check one of the actions.
4. Corrections or comments made on the submittals during this review shall not relieve Contractor from compliance with requirements of the Contract Drawings and Specifications. This check is only for review of general conformance with the design concept of and general conformance with the information given in the Contract Documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.
5. For Submittals marked "Rejected", or "Revise and Resubmit", the Architect will have prints made from the marked reproducible Drawings at the Contractor's expense. Such prints shall be used for record purposes and for comparison with subsequent resubmissions. One will be retained by the Architect, one furnished to the applicable consultants, if any, and the transparency returned to the Contractor. Such procedures shall be followed until the Shop Drawing is marked "Furnish as Corrected", or "Reviewed as required by the Construction Contract Documents and approved, but only for conformance to the design concept of the work, and subject to further limitations and requirements contained in the Contract Documents."
6. Submittals marked "Furnish as Corrected" shall be treated in the same manner as Drawings marked "Reviewed as required by the Construction Contract Documents...and

requirements contained in the Contract Documents." The Architect's comments shall be considered part of the original Drawings. Should the Contractor disagree with such comments, he shall so notify the Architect in writing within fourteen (14) days after receipt of such Drawings and before commencing work on the items in question. Failing this, the Contractor shall be deemed to have accepted full responsibility for implementing such comments at no additional cost to the Owner.

7. Transparencies for all Drawings marked "Furnished as Corrected" or "Reviewed as required by the Construction Contract Documents..." will be returned to the Contractor.
8. Before the transparency is returned by the Architect with the stamp "Reviewed as required by the Construction Contract Documents..." or "Furnish as Corrected", the Architect will have made at the Contractor's expense, four (4) prints of the corrected original for the Architect's and Owner's use.

B. Informational Submittals: Architect will review each informational submittal and will review it for general compliance with submittal requirements

1. Architect will process and distribute each informational submittal as for other submittals.
2. Compliant informational submittals will be marked “Reviewed” and stamped copies will be distributed to Owner’s Project Manager, Clerk of the Works and Contractor.
3. Informational submittals that do not comply with submittal requirements specified herein and in the section whose work they cover will be returned without any action or stamp. Re-submittal will be required.

C. Repeated Re-submittals: The Architect will review the initial submittal for each product, and one re-submittal if revisions are required.

1. If the first re-submittal is rejected or requires further revision, the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to perform review of an extensive number of repeated submittals, until a submittal for that product is accepted by the Architect with no need for further revision.
2. Refer to Section 011400 –WORK RESTRICTIONS, for procedures required in cases where Contractor is responsible to the Owner for costs for Additional Services of the Architect.

3.3 SUBSTITUTIONS

A. Definition: Substitutions are changes proposed by Contractor for products, materials, equipment, and methods of construction differing from those required by the Contract Documents.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Substitution is requested by completing a copy of Form 013301 – SUBSTITUTION REQUEST FORM, attached to the end of this Section.
2. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
3. Requested substitution does not require extensive revisions to the Contract Documents.
4. Requested substitution is consistent with the Contract Documents and will produce indicated results.
5. Substitution request is fully documented and properly submitted.

6. Requested substitution will not adversely affect Contractor's Construction Schedule.
7. Requested substitution has received necessary approvals of authorities having jurisdiction.
8. Requested substitution is compatible with other portions of the Work.
9. Requested substitution has been coordinated with other portions of the Work.
10. Requested substitution provides specified warranty.
11. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

C. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 working days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 working days of receipt of request, or 7 working days of receipt of additional information or documentation, whichever is later.

1. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

D. Review of Substitution Requests: The Architect will review Substitution Requests that are submitted in accordance with the requirements of this section and are shown to be of benefit to the Project.

1. If a request for substitution is incomplete, the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to perform additional review, until the substitution has been either accepted with no need for further revision or rejected.
2. If a request for substitution is shown to be of benefit to the Contractor only and not to the Project, the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to perform review, redesign or coordination due to such substitution.
3. Refer to Section 011400 –WORK RESTRICTIONS, for procedures required in cases where Contractor is responsible to the Owner for costs for Additional Services of the Architect.

E. Form of Acceptance of Substitution: Change Order

END OF SECTION

ATTACHMENT: FORM 013301 – SUBSTITUTION REQUEST FORM

FORM 013301

SUBSTITUTION REQUEST FORM

Project: **N. Reading Fire Station Renovation**

To: **HKT Architects**

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 is attached.

G. This substitution will amount to a credit or extra cost to the Owner of: _____

_____ Dollars

($_____).

Notes:

Submission of this form by the Contractor will not require the Owner to accept the proposed substitution unless the substituted product or system meets the requirements of Massachusetts General Law, Chapter 30, Section 39M and is acceptable to the Architect.

The Owner's acceptance of any substitution will not change the Contract Price, unless the Owner, Contractor and any other required parties execute a Change Order in accordance with the terms and provisions of the Contract Documents.

Refer to Section 013300 – SUBMITTAL PROCEDURES, for additional requirements for the submittal and processing of substitution requests.

Submitted By:_____
(signature)

Title: _____

Firm:_____

END OF FORM

SECTION 014000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes administrative and procedural requirements for

1. Quality assurance
2. Quality control

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate

their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Testing and Inspection Log: Submit updated copy of log each month with the Application for Payment.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Coordinate the work of multiple subcontractors as needed to build complete mockups of multi-component systems.
3. Notify Architect seven days in advance of dates and times when mockups will be con-

structed.

4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed, unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 50.

1.7 QUALITY CONTROL – owner responsibilities

A. General: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Testing, inspections and commissioning performed by the Owner or the Owner’s agents in no way reduce the responsibility of the Contractor to meet performance requirements, descriptive criteria and all other requirements of the specifications, nor do these activities on the part of the Owner relieve the Contractor from performing Quality Assurance and Quality Control measures specified.

B. Tests and Inspections: The Owner reserves the right to employ consultants and testing agencies to test the performance of the Work and to inspect the Work for conformance with the Contract Documents.

1. Notice for Testing: The Contractor shall give the Owner a minimum 24-hour notice when installations that require testing are ready for testing or inspection.

    a. Earlier notice shall be given where specified in a given technical section of the Specifications.
    b. If the Owner’s testing agency arrives at the site to test the performance of the work, and determines that the installation is not ready for testing or inspections, then the Contractor shall be responsible for the costs of the testing agency’s site visit

2. Availability of Test Results: The results of such tests and inspections will be made available to the Architect and Contractor.
3. Correction of Work:

    a. Where results demonstrate deficiencies in the Work, the Contractor shall take all actions necessary to correct the Work in a timely manner at their own expense.
    b. When the Contractor considers the Work to be corrected, further tests and inspections will be performed by the Owner’s consultants and testing agencies at the Contractor’s expense.

C. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

D. Costs for retesting and reinspecting construction that replaces or is necessitated by work that

failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

1.8 QUALITY CONTROL – contractor responsibilities

A. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

Schedule times for tests, inspections, obtaining samples, and similar activities.

G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

H. Air Leakage Testing:

1. Air leakage (determined by pressurization testing) must be less than 2.5 square inches/100 square feet surface area leakage ratio (CGSB, calculated at a 10 Pa pressure differential); or 1.25 square inches/100 square feet leakage ratio (ASTM, calculated at a 4 Pa pressure differential); or 0.25 CFM/square foot of building enclosure surface area at a 50 Pascal air pressure differential. The calculation of the building enclosure area includes the foundation or below-grade surface areas. If the house is divided into multiple conditioned zones, such as conditioned attics or conditioned crawl space, the blower door requirement must be met with the access to the space open, connecting the zones.
2. Blower Door Test for Overall Air Infiltration:

    a. Target: 1127 CFM 50 / 3.6 ACH 50 (cfm 50 = cubic feet per minute at 50 Pa).

3. Provide blower door testing assemblies equal to Minneapolis Blower Door by the Energy Conservatory.

    a. Model 3 Blower Door Fan

        1) Maximum Flow:

            a) 6,300 CFM at free air (2,973 l/s, 10,700 m3/h).
            b) 5,350 CFM at 50 Pa (2,524 l/s, 9,090 m3/h).

        2) Minimum Flow: 300 CFM with Ring B (141 l/s, 510 m3/h).

            a) 85 CFM with Ring C (40 l/s, 144m3/h).
            b) 30 CFM with Rings D (14 l/s, 51 m3/h).
            c) 11 CFM with Rings E (5 l/s, 18 m3/h).

b. Dimensions: 20 in. (50 cm) inlet diameter, 10.25 in (26 cm) length.
c. Weight: 33 lbs. (15 kg) with Flow Rings A & B.
d. Flow Accuracy: +/- 3% using DG-700 or APT system, Rings D & E +/- 4% or 1 CFM.
e. Calibration: Meets ASTM Standard E779-03, E1554-07, CGSB-149.10-M86, EN 13829, ATTMA Technical Standard 1 and NFPA 2001.
f. Power 110V or 220V.
g. Adjustable Frame and Frame Material:

1) Extruded Aluminum.
2) Frame Material Width: 28 in. to 40 in. (71 cm to 101 cm).
3) Heignt: 52 in. to 96 in. (132 cm to 244 cm).
4) Seal: EPDM flexible gasket.
5) Panel Material: Nylon w/built-in vinyl window.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Section 017329 – CUTTING AND PATCHING.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 014330

MOCKUPS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. General: Provide and coordinate mock-up assemblies at Project site for Architect's review and acceptance, in accordance with requirements of the Contract Documents. Refer to individual Specification Sections for mock-up requirements. Generally, without limitation, mock-ups on site include the following:

1. Mock-ups of individual pieces of the work, as specified within individual Specification Section.
2. Field Mock-Up of exterior wall components. Refer to the Drawings for extent of mock-up.

B. It shall be the responsibility of the Contractor to coordinate the work of the related Specification Sections so that each mock-up meets the specified requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Individual Specification Sections for Submittal Samples.

1.3 DEFINITIONS

A. In-Place Mock-Ups: Full-size, physical assemblies that are constructed in-place and remain part of final construction.

1. In-place mock-ups will be used to verify selections made under sample submittals, to demonstrate aesthetic effects, qualities of materials and execution, and to review construction, coordination, testing, or operation.
2. Approved in-place mock-ups establish the standard by which the Work will be judged.
3. Approved mock-ups remain part of the completed Work.

1.4 SUBMITTALS

A. Schedule: Construction Manager shall submit a schedule of mock-up construction, including dates for mock-up review by the Architect.

1. Mock-up schedule shall be reviewed at each progress meeting, revised and resubmitted as required.
2. Schedule shall allow sufficient time for mock-ups which are not accepted to be reconstructed and reviewed until accepted by the Architect.

B. Shop Drawings of Mock-Ups: Provide large scale shop drawings for fabrication, installation and erection of all parts of each mock-up. Provide plans, elevations, and details of anchorage, connections and accessory items.

C. Photographs of Mock-Ups: Submit photographs of mock-ups after completion of installation and acceptance of each mock-up.

D. Submittal Samples: Refer to individual Specification Sections for submittal requirements of mock-up components and coordinate accordingly.

1.5 QUALITY ASSURANCE

A. Design Modifications: Make design modifications to work only as required to meet performance requirements and to coordinate the work. Indicate proposed design modifications on shop drawings. Maintain original design concept without altering profiles and alignments indicated.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. Provide materials, components, and products for mock-ups as specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to PART 3, EXECUTION portions of the various Specification Sections for specific requirements regarding condition of surfaces, erection, and erection tolerances.

3.2 INDIVIDUAL MOCK-UPS

A. Provide individual mock-ups of types and sizes required by individual Specification Sections to evaluate and set the standard of quality for that work. Obtain Architect's acceptance of visual qualities prior to commencing work that individual mock-up is intended to represent. Protect and maintain approved mock-ups throughout the work of the Contract. Locate mock-ups at the Project site as directed by the Architect.

1. Provide as many mock-ups as required until Architect's approval has been received.
2. When indicated in individual Specification Sections, approved mock-ups may be incorporated into the finish work.

3.3 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as non-visible as possible.

B. Protect construction exposed by or for quality-control service activities.

3.4 REMOVAL AND DISPOSAL

A. Demolish and remove mock-ups not incorporated into the finish work from site at the completion of the Project. Legally dispose of demolished mock-up materials. Comply with requirements of Section 017400 – CONSTRUCTION WASTE MANAGEMENT.

END OF SECTION

SECTION 014533

CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The Latest Massachusetts State Building Code, under which this project is designed and will be built, requires the structural engineer of record (SER) to provide a program of structural tests and special inspections for this project in accordance with Chapter 17, 2015 International Building Code. The SER is the structural engineer who is in responsible charge of the preparation of the structural drawings and structural specifications for this project and whose Massachusetts professional engineering seal appears on said structural drawings.

B. The SER has prepared a document entitled Statement of Special Inspection, which has been or will be submitted to the building official who has jurisdiction over this project, with the application for a building permit.

C. The program of structural tests and inspections shall not relieve the Contractor or its subcontractors of their responsibilities and obligations for quality control of the work, their other obligations of supervising the work, for any design work which is included in their scope of services, and for full compliance with the requirement of the Contract Documents. Furthermore, the detection of, or failure to detect, deficiencies or defects in the Work during the testing and inspection conducted pursuant to the program shall not relieve the Contractor or its subcontractor of their responsibility to correct all deficiencies or defects, whether detects or undetected, in all parts of the Work, and to otherwise comply with all requirements of the Contract Documents.

D. The program of structural tests and inspection does not apply to the Contractor’s equipment, temporary structures used by the Contractor to construct the project, the Contractor’s means, methods, and procedures, and job site safety.

E. The structural testing and special inspection required by this Section is in addition to the inspections required by the Building Officials. Special inspection is not a substitute for inspection by a local municipal building inspector. Specially inspected work which is installed or covered without the approval of the Engineer or local municipal building inspector is subject to removal or exposure.

F. The Owner shall employ the Special Inspectors or approved Testing Agencies.

G. Special Inspector shall be an independently established and recognized agency regularly engaged in conducting tests or furnishing professional and inspection services and shall be approved by the Building Official and/or SER. The agency shall disclose all possible conflicts of interest so that objectivity can be confirmed. The agency shall have adequate equipment to perform all required tests. Personnel performing special inspection activities shall have qualifications according to the requirements for special inspector as noted below.

H. Special Inspectors as selected and approved by the Building Official and SER shall:

1. Be a qualified person, who shall have the minimum qualifications indicated in the Statement of Special Inspection, and demonstrate competence, to the satisfaction of the Building Official and SER, for inspection of the particular type of construction or operation requiring special inspection.
2. Be under the supervision of a professional engineer registered in the state in which work is under construction.
3. Observe the work assigned for conformance with the approved Drawings and Specifications and shall keep records of inspections or tests. The work inspected or tested shall be clearly identified, deficiencies noted, and resolutions stated.
4. Furnish inspection reports to the Architect, SER, Construction Manager/General Contractor, Owner, and the Building Official. Reports shall indicate that work inspected was done in conformance with approved construction documents. Discrepancies shall be brought to the immediate attention of the Contractor for correction, then, if uncorrected, the attention of the Building Official and SER prior to completion of that phase of work.
5. Submit a final signed report stating the work was in conformance with the approved Drawings and Specifications and the applicable workmanship provisions of the governing state code.

I. Special Inspector shall review this specification and Chapter 17 of the International Building Code. In the event of conflict with this specification and the Building Code, the Code shall govern.

1.2 CONTRACTOR'S RESPONSIBILITIES

A. Where the document *Statement of Special Inspections* indicates that a structural component or system is subject to structural tests and inspections by Chapter 17, 2015 International Building Code and that the SER for the project has not been retained to design said component or system or to prepare a performance specification for said component system, and the Architect has not otherwise provided for the structural design of said component or system, the Contractor shall retain, or require others under his direction to retain, a professional engineer registered in Massachusetts to design said component or system and to provide the required program of structural tests and inspections for said component or system.

B. The Contractor shall provide free and safe access to the Work for the SER and all other individuals who are observing the work or performing structural tests or inspections. The Contractor shall provide all ladders, scaffolding, staging, and up-to-date safety equipment, all in good and safe working order, and qualified personnel to handle and erect them, as may be required for safe access.

C. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.

1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.

END OF SECTION

Statement of Special Inspections

Project: *North Reading Fire Station*

Location: *North Reading, MA*

Owner: *Town of North Reading*

Design Professional in Responsible Charge: *Pare Corporation*

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project as well as the name of the Special Inspection Coordinator and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompasses the following disciplines:

☒ Structural ☐ Mechanical/Electrical/Plumbing

☐ Architectural ☐ Other: _____

The Special Inspection Coordinator shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: *Monthly* or ☐ per attached schedule.

Prepared by:

Kevin Champagne, P.E. Pare Corporation

(type or print name)

Signature Date

Design Professional Seal

Owner's Authorization:

Signature Date

Building Official's Acceptance:

Signature Date

Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- ☒ Soils and Foundations
- ☒ Cast-in-Place Concrete
- ☐ Precast Concrete
- ☒ Masonry
- ☒ Structural Steel
- ☐ Cold-Formed Steel Framing
- ☐ Spray Fire Resistant Material
- ☒ Wood Construction
- ☐ Exterior Insulation and Finish System
- ☐ Mechanical & Electrical Systems
- ☐ Architectural Systems
- ☐ Special Cases

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. **Special Inspection Coordinator**	*To Be Determined*	
2. SER – Structural Engineer of Record	*Pare Corporation*	*10 Lincoln Road, Suite 210* *Foxboro, MA* *(508) 543-1755*
3. GE – Geotechnical Engineer	*Pare Corporation*	*10 Lincoln Road, Suite 210* *Foxboro, MA* *(508) 543-1755*
4. OIAF – Owner's Inspection Agency (Field)	*To Be Determined*	
5. OIAP – Owner's Inspection Agency (Plant)	*To Be Determined*	
6. ARCH – Architect of Record	*HKT Architects, Inc.*	*24 Roland Street #301* *Boston, MA* *(617)-776-6545*

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

Quality Assurance Plan

Quality Assurance for Seismic Resistance

Seismic Design Category	*C*
Quality Assurance Plan Required (Y/N)	*No*

Description of seismic force resisting system and designated seismic systems:
(Not Required per IBC 2015 Section 1705.12 Exception 1, 1705.12.1.1 Exception 1, and 1705.12.2 Exception 1)

Quality Assurance for Wind Requirements

Nominal Design Wind Speed, V_{asd} (3 sec. gust)	*106*
Wind Exposure Category	*B*
Quality Assurance Plan Required (Y/N)	*No*

Description of wind force resisting system and designated wind resisting components:
(Not Required per IBC 2015 Section 1705.11, V_{asd} is less than 120 mph in Exposure B)

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and Testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and Testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge deems it appropriate that the firm* performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE*	Structural Engineer – under the supervision of, or a licensed SE or PE specializing in the design of building structures
PE/GE*	Geotechnical Engineer – under the supervision of, or a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.

International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

* denoted edits made by Pare Corporation

Other

Soils and Foundations

Item	Agency # (Qualif.)	Scope
1. Shallow Foundations (periodic)	*GE* *(PE/GE)*	*Inspect soils below footings for adequate bearing capacity and consistency with construction documents, specifications, and geotechnical report.* *Inspect removal of unsuitable material and preparation of subgrade prior to placement of fill.*
2. Testing of Fill Materials (periodic)	*GE* *OIAF* *(PE/GE)*	*Perform sieve tests (ASTM D6913 & D1140) and modified Proctor tests (ASTM D1557) of each source of fill material for conformance to the specifications. (OIAF)*
3. Placement of Fill Materials (continuous)	*GE* *OIAF* *(PE/GE)*	*Inspect placement, lift thickness, and compaction of fill (OIAF).*
4. Density of Fill Materials (continuous)	*SER* *GE* *OIAF* *(PE/GE)*	*Perform field density tests of the in-place fill in accordance with the construction documents and specifications (GE, OIAF).* *Review test reports for conformance to the construction documents (SER, GE)*

Cast-in-Place Concrete

Item	Agency # (Qualif.)	Scope
1. Mix Design (periodic)	*SER* *OIAF* *(ACI-CCI ICC-RCSI)*	*Review mix designs for all classes of concrete for conformance to specifications Proportioning of materials shall be in accordance with ACI318. (SER)* *Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design. (OIAF)* *Review OIAF reports (SER).*
2. Material Certification (periodic)	*SER*	*Review material certificates of compliance or other acceptable documentation for all materials used in the concrete mix designs for conformance with the construction documents.*
3. Reinforcement Installation (periodic)	*SER* *OIAF* *(ACI-CCI ICC-RCSI)*	*Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters. (SER, OIAF)*
4. Formwork Geometry (periodic)	*OIAF*	*Inspect formwork for general conformance with the construction documents. Review formwork to insure the finished concrete size and shape for conformance to the construction documents.*
5. Anchor Rods (periodic)	*SER* *OIAF*	*Inspect size, length, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors. (OIAF)* *Review OIAF reports (SER).*
6. Concrete Placement (continuous)	*SER* *OIAF* *(ACI-CCI ICC-RCSI)*	*Review ready mix truck delivery tickets for proper class of concrete and required admixtures. Inspect placement of concrete. Verify conformance to specifications including cold-weather and hot-weather placement procedures. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated. (OIAF)* *Review OIAF reports (SER).*
7. Sampling and Testing of Concrete (continuous)	*SER* *OIAF* *(ACI-CFTT ACI-STT)*	*Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231 or C173), lightweight concrete unit weight (ASTM C567), and temperature (ASTM C1064) for conformance with construction documents. (OIAF)* *Review concrete test reports for conformance with the construction documents (SER).*
8. Curing and Protection (periodic)	*PE* *OIAF* *(ACI-CCI ICC-RCSI)*	*Inspect curing, cold weather protection and hot weather protection procedures (OIAF).* *Review OIAF reports (SER).*
9. Post-installed anchors in hardened concrete (periodic) (sustained tension loads, continuous)	*SER* *OIAF* *(ACI-CCI ICC-RCSI)*	*Inspect in accordance with manufacturer's published installation instructions (MPII) and relevant evaluation report (ICC-ES ESR). Verify anchors installed in accordance with manufacturer's requirements including hole-cleaning procedures. Verify anchor size, placement, embedment depths, spacing, and edge distances meet construction document requirements. (OIAF)* *Review OIAF reports. (SER)*

Masonry

Required Inspection Level: ☐ **B** ☒ **C**

Item	Agency # (Qualif.)	Scope
1. Material Certification	*ARCH SER*	*Review all material submittals and certificates for each type of structural masonry unit, mortar, grout and admixtures for conformance to construction documents.*
2. Mixing of Mortar and Grout (continuous)	*OIAF (ICC-SMSI)*	*Inspect proportioning, mixing and retempering of mortar and grout. Conduct field review of mortar and grout proportioning, mixing and consistency for conformance with ACI 530.1 and the construction documents.*
3. Installation of Masonry (continuous)	*SER OIAF (ICC-SMSI)*	*Inspect size, layout, bonding and placement of masonry units. Inspection mortar application and grouting procedures for conformance with the construction documents (OIAF).* *Review all reports for conformance with the construction documents (SER).*
4. Mortar Joints (continuous)	*ARCH OIAF (ICC-SMSI)*	*Inspect construction of mortar joints including tooling and filling of head joints.*
5. Reinforcement Installation (continuous)	*OIAF SER (ICC-SMSI AWS-CWI)*	*Inspect size, quantity, condition, placement, positioning and lapping of reinforcing steel for approved shop drawings and construction documents. Inspect welding of reinforcing steel and inspect welder's certifications.(OIAF)* *Review OIAF test reports. (SER)*
6. Grouting Operations (continuous)	*OIAF (ICC-SMSI)*	*Inspect placement and consolidation of grout. Verify grout space is clean. Inspect masonry clean-outs for high-lift grouting.*
7. Weather Protection (periodic)	*OIAF (ICC-SMSI)*	*Inspect cold weather protection and hot weather protection procedures. Verify that wall cavities are protected against precipitation.*
8. Evaluation of Masonry Strength (Load-bearing walls only) Compliance with approved frequency (periodic) Preparation of specimens (continuous)	*SER OIAF (ICC-SMSI)*	*Sample and test the masonry mortar and grout, brick, concrete masonry units, and the concrete prism at the approved frequency for conformance with the construction documents (OIAF).* *Test compressive strength of mortar and grout cube samples (ASTM C780). (OIAF)* *Test compressive strength of masonry prisms (ASTM C1314). (OIAF)* *Review test reports for conformance with the specifications (SER).*
9. Anchors and Ties (size, type, condition - continuous) (installation – continuous)	*OIAF (ICC-SMSI)*	*Inspect size, location, spacing and embedment of dowels, anchors and ties.* *Inspect anchorage of masonry to structural members, foundation walls, or other construction, and installation of embedded items for conformance with construction documents.*
10. Veneer Installation and attachment to Back-up structure.	*ARCH OIAF*	*Observe the installation of the brick veneer, including loose lintels, acccessories, and attachments to the back-up structure for conformance with the construction documents, the approved shop drawings, and the approved sample panels and mock-ups.*

Structural Steel

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures	*SER* *OIAP* *(AWS/AISC -SSI ICC-SWSI)*	*Review each shop fabrication including fabricator's and welder's certificates and quality control procedures including steel joists and steel deck. Verify whether Fabricator holds a current AISC Category I or II certification, or is a member of the Structural Steel Fabricators. (OIAP).* *Review OIAP reports. (SER)*
2. Material Certification (periodic)	*SER* *OIAF* *(AWS/AISC -SSI ICC-SWSI)*	*Review certified mill test reports for structural steel including steel joists and steel deck. (SER)* *Verify identification markings on wide-flange shapes, high-strength bolts, nuts and welding electrodes. (OIAF)*
3. Bolting (Bearing Type - periodic) (Slip-Critical Type – continuous for turn of the nut or calibrated wrench method)	*SER* *OIAF* *(AWS/AISC -SSI ICC-SWSI)*	*Inspect installation and tightening of high-strength bolts. Verify bolt size and grade and that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip-critical connections. (OIAF)* *Review reports (SER).*
4. Welding (continuous except periodic for single pass fillet welds < 5/16" or floor and deck welds)	*SER* *OIAF* *(AWS-CWI ASNT)*	*Visually inspect all welds in accordance with construction documents and approved shop drawings. Inspect pre-heat, post-heat and surface preparation between passes. Verify size and length of fillet welds. (OIAF)* *Continuous inspection of ultrasonic testing of all full-penetration welds. (OIAF)* *Review all reports. (SER)*
5. Shear Connectors (periodic)	*PE* *OIAF* *(AWS-AISC-SSI ICC-SWSI*	*Inspect size, number, positioning and welding of shear connectors. Inspect suds for full 360 degree flash. Ring test all shear connectors with a 3 lb hammer. Bend test all questionable studs to 15 degrees (OIAF)* *Review test reports for conformance. (SER).*
6. Structural Framing, Details, and Assemblies (periodic)	*SER* *OIAF* *(PE/SE)*	*Visually inspect steel frame for compliance with structural drawings, approved erection and shop drawings, AISC Code of Standard Practice including bracing, member configuration and connection details. (OIAF)* *Inspect for size, grade of steel, camber, and installation. (OIAF)* *Review test reports for conformance with approved shop drawings and construction documents. (SER)*
7. Steel Deck Installation	*SER* *OIAF* *(AWS-CWI)*	*Inspect placement, laps, support fasteners and side-lap fastening of metal deck as per approved shop drawings (OIAF).* *Review OIAF reports (SER).*

Wood Construction

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures	*SER OIAP*	*Review each shop fabrication including fabricator's quality control procedures including trusses and panelized construction. (OIAP).* *Review OIAP reports. (SER)*
2. Material Grading (periodic)	*SER OIAF*	*Review all material submittals and certificates for compliance with the construction documents (SER).* *Inspect wood species, grade, and dimensions for blocking, rim boards, and top plates for compliance with approved submittals/construction documents. (OIAF)*
3. Connections and Fasteners (periodic)	*SER OIAF*	*Review all material submittals and certificates for compliance with the construction documents (SER).* *Inspect hardware (hold-downs, straps, ties, rods, nuts, anchors) and fasteners for size, type, grade, and location specified in approved submittals/construction documents. Verify hardware installed per manufacturer's procedures. (OIAF)* *Review OIAF test reports (SER).*
4. Framing and Details (periodic)	*SER OIAF*	*Inspect blocking, rim boards, and top plates installation for compliance with construction documents (OIAF)* *Review OIAF test reports (SER).*
5. Diaphragms and Shear Walls (periodic)	*SER OIAF*	*Inspect size, configuration, stud spacing, blocking and fastening of shear walls and diaphragms. Verify panel grade and thickness. (OIAF)* *Review OIAF test reports (SER).*

Final Report of Special Inspections

Project:

Location:

Owner:

Owner's Address:

Architect of Record:

Structural Engineer of Record:

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector Coordinator

(Type or print name)

Signature Date

Licensed Professional Seal

Final Report of Special Inspections

Agent's Final Report

Project:

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Testing Agency

(Type or print name)

Signature Date

Licensed Professional Seal or Certification

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following:

1. Temporary facilities and services.
2. Temporary water.
3. Weather protection
4. Temporary heating and ventilating
5. Temporary humidity control.
6. Temporary electricity and lighting
7. Temporary telephone
8. Temporary sanitary facilities
9. Temporary fire protection
10. Temporary stairs and ladders
11. Temporary hoists and chutes
12. Staging and scaffolding
13. Temporary use of elevators
14. Temporary enclosures
15. Protection of work, property and the public
16. Security of the work
17. Rodent control.
18. Water control
19. Snow and ice control
20. Construction fence
21. Project signs
22. Temporary offices

1.3 SUBMITTALS

A. General: Refer to Section 013300 – SUBMITTAL PROCEDURES, for submittal provisions and procedures.

B. Informational Submittals: Submit the following plans for temporary protection and facilities as specified in this Section:

1. Weather protection plan
2. Temporary humidity control procedures
3. Temporary heating plan
4. Temporary fire protection plan.

1.4 TEMPORARY FACILITIES AND SERVICES

A. Contractor shall be responsible for arranging and providing temporary facilities and general services at the site as specified herein and as otherwise required for proper and expeditious prosecution of work. Except as otherwise specified, the Contractor shall pay costs 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. 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 of the Architect and the Owner, shall remove temporary installations and conditions when no longer required, and shall restore the services and sources of supply to proper operating condition as approved by the Architect.

D. Discontinuance of any temporary service prior to the completion of any portions of the Work shall not render the Owner liable for any additional cost resulting therefrom.

E. Should a change in location of any temporary equipment be necessary in order for the Work to progress properly, Contractor shall remove and relocate such equipment as required without additional cost to the Owner.

F. Temporary Parking Lot: Construct temporary parking lot shown on approved Logistics Plan for temporary use of Owner and Contractor during construction. Demolish temporary parking lot and restore area for permanent use as shown on Drawings.

1.5 TEMPORARY WATER

A. Furnish potable water for construction purposes for trades at a point within 10 feet of building being constructed. Make arrangements and pay charges for water service installation, maintenance, and removal thereof, and pay costs of water for all trades.

B. After installation, permanent water supply and distribution system may be used as source of water for construction purposes, provided that the Contractor pays applicable municipal water costs and assumes responsibility for damage to water distribution system and pays costs of restoration of system where so damaged.

C. Temporary pipelines and connections from the permanent service line, either outside or within the building, necessary for the use of the Contractor and his Subcontractors shall be installed, protected and maintained at the expense of the Contractor.

D. In addition to temporary lines and connections, the Contractor, if required by the Owner, shall at the Contractor's expense install a temporary meter in a frostproof box in such location and in such manner as may be approved by the Architect.

E. Provide an adequate supply of drinking water from approved sources of acceptable quality, satisfactorily cooled, for Contractor's employees and those of his Subcontractors. Where required, furnish drinking water in suitable containers and provide single-service cups for use of employees. Drinking water dispensers shall be conveniently located in building where work is in progress.

F. At completion of construction work, temporary water service equipment and piping shall be removed by Contractor.

1.6 WEATHER PROTECTION

A. It is the intent of these Specifications to require the Contractor to provide temporary enclosures and heat to permit construction work to be carried on during the months of November through March in compliance with Massachusetts General Laws. These Specifications are not to be construed as requiring enclosures or heat for operations that are economically infeasible to protect in the judgment of the Architect. Included in this category, without limitation, are such items as site work, excavation, pile driving, steel erection, erection of certain exterior wall panels, roofing, and similar operations.

B. "Weather Protection" shall mean 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 Architect and consistent with the approved 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 all "weather protection" material and be responsible for all costs, including heating required to maintain temperature of 40 degrees F. at the working surface. This provision does not supersede any specific requirements for methods of construction, curing of materials or to performance obligations of the Contractor.

C. Within 30 calendar days after award of Contract, the Contractor shall submit in writing to the Architect for approval, three (3) copies of his proposed methods for weather protection.

D. Installation of weather protection shall comply with all safety regulations including provisions for adequate ventilation and fire protection.

E. Determination of extent of work to be performed during winter months shall be by the Contractor, with Owner's approval provided that work shall proceed at such a rate as to insure Substantial Completion on or before the stipulated date in accordance with the Progress Schedule.

F. Be responsible for providing protection against damage to materials and work installed in freezing weather by providing special heat and coverings to prevent damage by the elements, in a manner approved by the Architect. Protect the ground surfaces under footings, under pipelines, under masonry, under concrete and other work subject to damage, against freezing or ice formation. If low temperature makes it impossible to continue operations safely in spite of cold weather precautions, cease work, and so notify the Architect.

1.7 TEMPORARY HEATING AND VENTILATING

A. Within thirty (30) calendar days after commencement of work under this Contract, the Contractor shall submit in writing to the Architect for approval, three (3) copies of his method and time schedule for heating during construction, which shall concur with his general Progress Schedule.

B. Temporary weather-tight enclosures and temporary heating shall be provided by the Contractor as required during construction to make the building weather-tight and to protect work from freezing and frost damage. All costs of closing in buildings, and all costs of temporary heat shall be paid for by the Contractor until Substantial Completion.

C. Contractor shall provide for temporary heating and shall pay fuel costs for heating directly to the utility company. Contractor may not tie into the Owner's permanent heating and ventilating system. In areas of building where work is being conducted, temperature shall be continuously maintained as specified in Sections of Specifications but not less than 50 degrees F. nor more than 75 degrees F.

D. Furnish and install one accurate recording Fahrenheit thermometer at a place designated by the Owner, located as directed by the Owner in order to determine that the specified temperatures are being maintained.

E. When work has progressed sufficiently for installation of glazing, Contractor may, if approved by Architect, use glazed windows in place of temporary enclosures. Permanent windows shall be protected against damage from mortar, cement, plaster, etc., and from damage by other trades; and upon completion of work shall be thoroughly cleaned, damaged component parts including glass shall be satisfactorily repaired or replaced, and windows left in perfect condition, prior to Substantial Completion.

F. Where building systems are inoperable, temporary heating shall be by smokeless portable unit heaters, steam generators or forced warm air heaters (UL, Factory Mutual, Fire Marshall approved), located outside building or vented to the outside. Contractor shall pay for fuel, maintenance and attendance required in connection with temporary heat. Surfaces, interior or exterior, damaged by use of these space heaters shall be replaced by new materials or be refinished to the satisfaction of the Architect without additional cost to the Owner. Use of oil burning "salamanders" is forbidden and nonvented open flame heaters will not be permitted inside after the building is closed in. Do not use propane-fueled heaters inside building or near stockpiles of combustible materials.

G. When new heating system, or suitable portion thereof, is in operating condition, such system may be used for temporary heating, provided that the Contractor obtains written approval of Architect and Owner.

H. Use of permanent air handling facilities for construction heating purposes will not be permitted.

I. Make periodic inspections of the equipment and controls to insure proper operation of the system, as conditions require, and report any failings. Installation and operation of weather protection and heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection.

J. Upon conclusion of temporary heating period, Contractor shall remove temporary piping, temporary radiators, other equipment and pay costs in connection with repairing damaged caused by installation or removal of temporary heating equipment and shall thoroughly clean and recondition those parts of permanent heating system used for temporary service.

K. Provide adequate ventilation as required to keep temperature of building within 10 degrees of ambient outdoor temperature when such. ambient temperature exceeds 70 degrees F., and to prevent accumulation of excess moisture in building. Refer to Section for Indoor Air Quality Control, for additional requirements for ventilation during construction

1.8 TEMPORARY HUMIDITY CONTROL

A. Humidity Control of Enclosed Building: The contractor shall install the following equipment to monitor and regulate relative humidity as required for the installation of all interior products. Humidity control equipment shall include, but not be limited to, the following:

1. Hygrometer: Provide one device to measure temperature and relative humidity in each construction area.
2. Dehumidifier, as required to maintain humidity of enclosed areas below 70%:
3. Fans: As required to eliminate significant variation in humidity levels within enclosed spaces.

B. Schedule for Humidity Control: Relative humidity shall be maintained within the limits set by manufacturers of all interior materials and equipment. Refer to individual specification sections in Divisions 6, 9, 10, 11 and 12 for additional environmental requirements. No interior construction product shall be installed or applied prior to enclosure of building and installation of temporary humidity control measures.

C. Within 30 calendar days after award of Contract, the Contractor shall submit in writing to the Architect for approval, three (3) copies of his proposed methods for humidity control.

1.9 TEMPORARY ELECTRICITY AND LIGHTING

A. Make arrangements as required with local electric company for temporary electric service, pay expenses in connection with installation, operation, and removal thereof, and pay cost of energy consumed by all trades until Substantial Completion of the building. Contractor shall make payments for electrical service directly to the electric company.

B. Take care not to overload equipment and lines. Provide and relocate temporary electric meters as required.

C. Power: Provide power distribution as required throughout new structure 120/208 volt, 3 phase, 60 cycle AC. Termination of power distribution shall be at one location in each major section of building, approximately at center. Termination shall be provided complete with circuit breakers, disconnect switches and other electrical devices as required to protect power supply system. Submit plan showing electrical distribution locations for Architect's approval.

D. Lighting: Temporary lighting system shall be furnished, installed and maintained by Contractor as required to satisfy minimum requirements of safety and security. Temporary lighting system shall afford general illumination in building areas and supply not less than one (1) watt per square foot of floor area for illumination in areas of building where work is being performed. Provide adequate outdoor lighting to illuminate staging, stockpiles, trenches, projections, office trailers etc., to the satisfaction of the Architect, and general illumination throughout adequate for watchmen and emergency personnel.

E. Safety: All temporary equipment and wiring for power and lighting shall be furnished and installed in conformity with the National Electrical Code and in accordance with local ordinances and requirements of the municipal power authority. All temporary wiring and accessories shall be maintained in a safe manner and utilized so as not to constitute hazard to persons or property and shall be removed after they have served their purposes.

F. When permanent electrical power and lighting systems are in operating condition, they may be used for temporary power and lighting for construction purposes, provided that Contractor obtains written approval of Architect and Owner. If permanent lighting fixtures are used in temporary light, provide new lamps for fixtures used for temporary light before Substantial Completion of the Work.

G. At completion of construction work, or at such time as Contractor makes use of permanent electrical installation, temporary wiring, lighting and other temporary electrical equipment and devices shall be removed by Contractor.

1.10 TEMPORARY TELEPHONE

A. Arrange with local telephone company to provide direct line telephone service at each construction site. Provide:

1. One direct line instrument in Field Office for the Contractor with electronic answering machine.
2. Two direct line instruments in Field Office of the Clerk of the Works equipped with electronic answering machine; plus one direct line for facsimile machine in office. Turn over keys to Clerk of the Works and Architect.
3. Two (2) Nextel Motorola i530 Mobile Phones with Nextel National 500 Plans for use by the Clerk of the Works.
4. High Speed internet access and router via DSL, Broadband, Cable, or equal with unlimited internet access to the Field offices of the Contractor and Clerk of the Works.
5. Other instruments at the option of the Contractor, or as required by regulations.
6. Each Subcontractor shall make his own arrangements for telephone service.

B. Pay for installation and removal of temporary telephones and facsimile lines and for all calls and fixed charges in connection therewith; including unlimited long-distance calling.

C. Temporary telephone services shall be maintained until Substantial Completion of the Work.

1.11 TEMPORARY SANITARY FACILITIES

A. Contractor shall provide an adequate number of toilet facilities with chemical type toilets and temporary lighting rented from and serviced by an approved company, as necessary for all persons engaged on the Work. Provide separate facilities for male and female workers.

B. Toilets shall be erected in location approved by the Architect, shall be maintained by the Contractor in a clean and orderly condition in compliance with all local and State health requirements, and shall be removed at Substantial Completion of the Work.

C. Permanent toilet facilities shall not be used by the Contractor, Subcontractors or any persons engaged by them during the course of work under this Contract.

1.12 TEMPORARY FIRE PROTECTION

A. Provide and maintain adequate temporary fire protection in the form of barrels of water with buckets, fire bucket tanks, fire extinguishers, or other effective means of extinguishing fire, ready for instant use, distributed around the Project and in and about temporary inflammable structures during construction of the Work.

B. Within 30 calendar days after award of Contract, the Contractor shall submit in writing to the Architect, three (3) copies of his proposed methods for fire protection that have been reviewed and approved by the local Fire Department. Post a copy of the approved fire protection plan in the Field Office for reference.

C. Gasoline and other flammable liquids shall be stored in and dispensed from UL listed safety containers in conformance with National Board of Fire Underwriter's recommendations. Storage shall not be within building.

D. Make arrangements for periodic inspection by local fire protection authorities and insurance underwriter's inspectors. Cooperate with said authorities and promptly carry out their recommendations.

E. Tarpaulins used during construction work shall be made of material that is resistant to fire, water, and weather. Tarpaulins shall have UL approval and comply with FS-CCC-D-746.

F. Torch-cutting and welding operations performed by Subcontractors shall have approval of Contractor before such work is started and chemical extinguisher shall be available within sight and not over ten (10) feet from location where such work is in progress.

G. Do not light fires in or about premises.

1.13 TEMPORARY STAIRS AND LADDERS

A. Each trade shall provide its own ladders where such ladders do not exceed a height of eight feet. Where ladders over eight feet, or stairs, steps or ramps of any height are required, the Contractor shall provide the entire installation, including the first eight feet.

B. All such apparatus, equipment and construction shall meet all requirements of Federal, State and local laws applicable thereto.

C. As soon as permanent stairs are erected, Contractor shall provide temporary protective treads, handrails, and shaft protection at stair locations.

1.14 TEMPORARY HOISTS AND CHUTES

A. Each trade shall provide its own hoists, including associated rigging, conveyance apparatus and chutes, where the maximum elevation of such hoists does not exceed a height of eight feet. Where hoists with elevations over eight feet are required, the Contractor shall provide the entire installation, including the first eight feet, and also including associated rigging, conveyance apparatus and chutes.

B. Construction, maintenance and operation of material hoists shall conform to applicable requirements of the "Standard Safety Code for Building Construction", ANSI; to AGC "Manual" requirements and to State and local regulations.

C. Temporary ladders, ramps, runways, chutes, derricks, stairs, and similar items required for proper execution of Contractor's work and that of his Subcontractors shall be properly maintained. Use of such facilities by other contractors, subcontractors and trades shall be permitted as required by construction schedule. Hoists and chutes shall be so constructed as to prevent damage, staining and marring of permanent work.

D. No materials, rubbish or debris, shall be permitted to drop free, but shall be removed by the use of material hoist and/or fully enclosed rubbish chute.

E. Provide openings in slabs, roofs, walls and partitions, where required, for moving in large pieces of equipment. Close and restore openings and finish them after equipment is in place. Structural modification, if required, shall be subject to prior written approval by the Architect.

1.15 STAGING AND SCAFFOLDING

A. Responsibility for Staging:

1. Staging eight feet or less in height: Each trade shall provide staging and scaffolding required for its work, where such staging and scaffolding does not exceed a height of eight feet.
2. Staging greater than eight feet in height: Where staging or scaffolding over eight feet high is required, the General Contractor shall provide the entire installation, including the first eight feet.

3. The General Contractor shall coordinate the use of staging and scaffolding as required to permit trades to perform the Work in a timely manner.

B. Construction Requirements for Staging: The General Contractor is responsible for safety of staging and scaffolding, including but not limited to the following requirements:

1. Staging shall be of approved design, erected and removed by experienced stage builders, and shall comply with all applicable OSHA standards.
2. Provide accident prevention devices required by State and local laws.

1.16 TEMPORARY USE OF ELEVATORS

A. Make arrangements with Elevator Subcontractor for temporary use of elevators, if required, during construction period, and for normal use by all trades and Subcontractors.

B. Make arrangements for provision of temporary cab enclosures, cars, car switches, gate contacts, power, signaling devices, temporary hoistway openings, protection of permanent hoistway entrances and other installed finished work, and all such other items as are necessary to permit temporary operation in accordance with local, State and national codes.

C. Arrange with Elevator Subcontractor for all necessary maintenance of elevators during period of temporary operation and for restoration of elevators to their original, perfect condition with guarantees as specified. All costs in connection with temporary operation of elevators shall be paid by the Contractor.

D. Do not abuse, overload or otherwise damage elevators in temporary use for construction purposes.

1.17 TEMPORARY ENCLOSURES

A. Provide temporary weather tight enclosure of exterior walls as necessary to provide acceptable working conditions, provide weather protection for interior materials, allow for effective temporary heating, and to prevent entry of unauthorized persons.

B. Provide temporary exterior doors with self-closing hardware and padlocks. Permanent door enclosures shall not be used as temporary enclosures. Other enclosures shall be removable as necessary for work and for handling of materials.

C. Refer to Section INDOOR AIR QUALITY CONTROL, for requirements for temporary interior partitions to enclose portions of the work where required for protection of indoor air quality.

D. Relocate temporary enclosures as required by progress of construction, by operations of the building, or work requirements, and to accommodate legitimate requirements of Owner and Subcontractors employed at the site.

E. Completely remove temporary materials, equipment and services when enclosure needs can be met by use of permanent construction and at completion of the Project.

1.18 PROTECTION OF WORK, PROPERTY AND THE PUBLIC

A. Furnish, erect, and maintain, until such time as removal is approved by the Architect, temporary fencing and barricades to extent recommended by OSHA and as otherwise required for the protection of life and property during operations under the Contract.

B. Construct barricades and protective facilities in accordance with local and State regulations. Furnish and install all signs, lights, reflectors, and all such protection facilities as may be required.

C. Contractor shall save the Owner harmless from all claims arising from the use of public streets, sidewalks, and adjoining premises for construction purposes.

D. Keep all access roads and walks clear of debris, materials, construction plant and equipment during building operation. Repair streets, drives, curbs, sidewalks, fences, poles and the like where disturbed in building operation and leave them in as good condition after completion of the Work as before operations started.

E. Protect all planting, landscaping, trees and site improvements to remain.

F. The Contractor shall be responsible for the maintenance of construction barriers and traffic barriers in order to maintain traffic around the Work with the maximum of safety and practical convenience to such traffic during the life of the Contract, and whether or not work has been suspended temporarily. He shall take all precautions for preventing injuries to persons or damage to property on or about the Work.

G. Work shall be carried on and barriers erected in such a manner as to provide safe passage at all times for public travel and with least obstruction to traffic. The Contractor shall provide and maintain at his own expense in a safe and passable condition such temporary bypasses created by the barriers as may be necessary to accommodate both pedestrian and vehicular traffic.

H. Whenever gale or high winds are forecast, take proper measurements to secure all loose material, equipment or other items that could blow about and be damaged or cause damage to other work. No such loose items shall be left unsecured at end of working day. Particular attention shall be taken with scaffolding and items placed or stored on roofs or within the structure prior to being enclosed.

I. Remove all snow and ice which may impede work, damage the finishes or materials, be detrimental to workers, or impede trucking, delivery, or moving of materials at the job site, or prevent adequate drainage of the site or adjoining areas.

J. Be responsible for all breakage of glass from the time construction operations commence in each portion of the Project until each portion of the Project is occupied by the Owner. Unless glass has been broken by the Owner or his representatives, or by other separate prime contractors, the cost of glass replacement shall be borne by Contractor.

1.19 SECURITY OF THE WORK

A. The Contractor shall be responsible for providing any and all security precautions necessary to insure adequate protection of his and the Owner's interests.

B. Take all required measures to protect the Work at all times against fire, storm, theft, vandalism and other losses.

C. The Contractor shall be wholly responsible for patrolling and protecting the work under construction and the materials stored on the site; and shall reimburse the Owner for any losses, damage or injury not compensated by insurance, except those directly caused by the Owner, his agents or his employees.

D. The Contractor shall rebuild, repair, restore and make good all damage to any portion of the Work occasioned by any of the above causes before completion and written acceptance of the completed Work, and shall bear the expense thereof. No extension of time will be allowed in such cases.

E. Should the Contractor fail to take prompt action whenever conditions make it necessary, the Owner may make emergency repairs or cause the same to be made, with the stipulation that the costs for such repairs shall be charged against the Contractor and deducted from monies due to him.

1.20 RODENT CONTROL

A. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents and to perform extermination and control procedures at regular intervals so Project will be free of rodents and their residues at Substantial Completion.

1. Obtain extended warranty for Owner.
2. Perform control operations lawfully, using environmentally safe materials.
3. The Contractor's attention is brought to the fact that a portion of the building will be occupied by the Police Dept. Every effort shall be made to avoid applications of materials that will in any way compromise their health.

1.21 WATER CONTROL

A. Take over responsibility for site drainage in work areas upon entering the premises and maintain such drainage during the life of this Contract in a manner approved by the Architect and so as not to adversely affect adjacent areas or abutting property.

B. During the progress of the Work, provide and maintain all required pumps, suction and discharge lines, and power in sufficient number and capacity to keep all excavations, pits, trenches, foundations, and the entire property area free from accumulation of water from any source whatsoever, at all times, and under any and all circumstances and contingencies that may arise.

1.22 SNOW AND ICE CONTROL

A. De-icing Materials:

1. General: Comply with state and local regulations.

B. Snow Storage:

1. General: Comply with state and local regulations.

PART 2 - PRODUCTS

2.1 CONSTRUCTION FENCE

A. Furnish, install, maintain, and pay for temporary fencing and other protection required for the safety of the Work and of stored materials and equipment. Provide temporary construction fence as required for public safety and protection around entire construction area at the Limit of Work line, at each site as shown on Drawings. Fence shall be installed in a manner that will not impact wetlands.

B. 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.

C. 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 Owner to facilitate emergency access by Owner's Security Forces and local Police and Fire Department.

D. All fencing shall be in accordance with local ordinances and shall be removed at such time before Final Acceptance as the Architect directs. Restore site to acceptable condition after removing fence.

E. Vehicular access to the site, and parking for Contractor's employees' vehicles shall be restricted to the specific areas designated by the Owner.

2.2 PROJECT SIGNS

A. Provide in a location designated by the Architect one (1) sign, 4 feet by 8 feet in size, with three 4-inch by 4-inch post supports. Sign shall be fabricated from 3/4 inch thick medium density overlaid exterior plywood, edged continuously with 3/4 inch square pine banding. Apply one coat of exterior primer and two coats of exterior gloss enamel to all surfaces of sign and supports.

B. Sign shall be professionally produced and shall indicate: (1) the name of the Project, (2) the name of the Owner, (3) the name of the Contractor, (4) names and addresses of the Architect and Consulting Engineers, and (5) MSBA information. Graphic images and lettering, including type size, style and colors, will be provided by the Architect prior to beginning of construction. Architect will provide layout in electronic disc format or printed copy for sign production.

C. Provide directional signs as required to properly control construction traffic at each site.

D. No other signs or advertisements will be allowed on building or premises.

E. Erect where required for DEP File No. in accordance with Wetland Regulations and the Order of Conditions where applicable.

2.3 TEMPORARY OFFICES

A. Provide, maintain, and pay all costs in connection with temporary offices; including but not limited to office furniture, office equipment, and exhaustible office supplies.

B. In addition to his own requirements, the Contractor shall provide and bear all costs for completely enclosed weathertight structure equal to Williams Scotsman Model MO6012; not less than 60'-0" x 12'-0" in area for use of the Owner, the Architect, and their representatives. The trailer shall have two offices and a conference room, a reasonable amount of natural light, adjustable natural ventilation, and two exterior doors with dead bolt locks accessible and keyed from the outside. In addition include the following equipment:

1. One private toilet facility with running water within the structure.
2. Heat during cold weather below 55 degrees F.
3. One layout table, approximately 36" x 84" with one drafting stool and two drafting lamps with bulbs.

4. Two desks (30x60 standard double pedestal)and two desk chairs (swivel type with arms) in separate offices. One desk and one desk chair in the main area.
5. Twelve straight back folding chairs.
6. Four metal file cabinets (4 drawers each) with locks.
7. One plan rack to accommodate at least 6 sets of drawings.
8. Two desk-type telephones.
9. One electronic telephone answering machine.
10. One coat rack, two wastepaper baskets, and one 30"x40" wall-mounted tackboard.
11. One exterior high quality mercury thermometer.
12. Air conditioning during weather above 75 degrees F.
13. Two conference tables, 36" x 72" and 8'-0" of 12" deep shelving.
14. Sufficient number of electric lights (50 fc at desk level over entire area) and outlets.
15. One electrostatic copying machine, capable of copying, sorting, stapling, and collating equal to Xerox model XC830 or Sharp Z-820 with toner and drum cartriges. The copier shall have a 100-sheet paper drawer, able to reduce 30%, enlarge 40% and produce letter and legal size copies. Provide letter and legal size paper supply for the duration of the work
16. One facsimile transmitting and receiving machine with dedicated telephone line.
17. Once digital camera equal to USA PowerShot S45 and direct interface data cable.
18. Supplies: Office supplies, including toners for all equipment, four (4) pairs of boots, four hard hats, and raincoats, one water-cooler with refrigerator, paper cups, and weekly bottle replacement for the duration of the project.
19. One industrial quality wall-mounted first aid kit sized and supplied for 10 people.
20. One automatic coffee machine.
21. One new computer equal to or better than a Dell Dimension 4550 Series Pentium 4 processor at 2.66 GHz w/ 533 MHz front side bus/512K L2 Cache, 333MHz DDR SDRAM, 512mb RAM. Include a Dell quitekey keyboard, a new 17 in E171 FPb Flat Panel Display, a Video Card equal to or better than 64mb DDR NVIDIA GeForce MX Graphics Card with TV-Out, a Hard Drive with a minimum of 60 GB Ultra ATA/100 7200 RPM, a 3.5 floppy disk drive, an operating system equal to MS Windows XP Professional, a Logitech Optical USB or equal mouse, a Network to include Integrated Intel Pro 10/100 Ethernet or equal and related cord, a 56K PCI Data/Fax Modem and related cord, a CD/DVD Drive equal to 48x/24x/40x Max CD-RW/DVD Combo Drive, a Sound Card equal to Sound Blaster Live 5.1 Digital Sound Card, a Speaker equal to Harmon Kardon HK-206, a zip drive equal to 250 mb Iomega ZIP Built-in Drive, and Software equal to MS Office XP Small Business. All items, including related power cords, adapters, surge suppressors, and other misc items necessary to operate the equipment are to be installed and made operational for use by the Owner.
22. One printer equal to the HP Officejet all-in-one printer/scanner/fax; include all related cables and driver software.

C. Heat and Air Conditioning shall be maintained to provide an indoor air temperature of 76 degrees F at 72 inches above the floor and throughout the space during the cooling season and 70 degrees F at 30 inches above the floor during the heating season.

D. Electrical Convenience Power: Provide convenience outlets for at least 2400 watts and at least 2 convenience circuits independent of the lighting, equipment power, and heating needs.

E. Offices shall be located in location approved by the Architect, shall be maintained by the Contractor in a clean and orderly condition, and shall be removed at Substantial Completion. The Contractor shall provide a cleaning service in each office at regular intervals (at least weekly).

F. Provide routine emergency service for office equipment specified and reasonable quantities of expendable supplies as required for job related use. When the sitework and building has been

completed to the extent that removal of the temporary structures is required, the Contractor shall provide a fully organized and connected temporary office spaces within the building located in and area approved by the Architect.

G. All office equipment provided under this Section shall be the property of the Contractor and shall be removed at Substantial Completion; except the computer, camera, printer, and associated hardware and software for which the titles and licenses shall be transferred to the Awarding Authority before final acceptance of the Project.

PART 3 - EXECUTION (NOT USED])

END OF SECTION

SECTION 017329

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section covers procedural requirements for cutting and patching, including but not limited to the following:

1. Standard requirements for all cutting and patching to be done on the Project, whether by the General Contractor, Filed Sub-Contractors or other subcontractors.

B. Refer to the following Sections for related work:

1. Section 015000 – TEMPORARY FACILITIES AND CONTROLS, for temporary protection, shoring and construction aids.
2. Section 017400 – CONSTRUCTION WASTE MANAGEMENT, for disposal of demolished materials.
3. Division 2 through Division 14 Sections, for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
4. Section 033000 – CAST-IN-PLACE CONCRETE, for cutting, patching and repair of concrete.
5. Section 042000 – UNIT MASONRY, for cutting and patching of existing masonry for the work of all trades, unless otherwise provided herein.
6. Section 042000 – UNIT MASONRY, for installation of lintels where required for all penetrations through new and existing masonry.
7. Section 055000 – METAL FABRICATIONS, for furnishing of lintels where required for all penetrations through new and existing masonry.
8. Section 078400 – FIRESTOPPING, for patching fire-rated construction.
9. Division 9 – FINISHES, for all patching of new and existing construction, except for masonry and concrete.
10. Section 092900 – GYPSUM BOARD, for cutting and patching gypsum wallboard construction.
11. Section 099000 – PAINTING AND COATING, for final preparation of existing, new and patched surfaces as required for application of paint, and for paints and coatings applied to patched surfaces.
12. Division 21, 22, 23 – MECHANICAL and Division 26 – ELECTRICAL, for coring and drilling for all items to be installed by mechanical and electrical trades, except as otherwise indicated.
13. Division 21, 22, 23 – MECHANICAL and Division 26 – ELECTRICAL, for items to be installed by mechanical and electrical trades, except as otherwise indicated.

1.3 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.

1.4 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 acoustical rating of adjacent construction.
2. Refer to Section 078400 – FIRESTOPPING, for requirements for maintaining the integrity of fire-rated construction at penetrations.

B. Coordination: The General Contractor shall be responsible for the following:

1. Obtain locations and dimensions of penetrations required through walls and floors from trades requiring penetrations.
2. Coordinate those penetrations with the requirements of other trades.
3. Forward locations and dimensions of requested penetrations to the trades responsible for performing the cutting and patching work.

C. Modifications with Structural Implications:

1. Non-masonry construction: Provide new penetrations and other work where modification to existing structural elements is shown on the Drawings.
2. Masonry construction: Coordinate the work of Subcontractors as required where modification to existing load-bearing masonry is shown on the Drawings.
3. Do not perform any work that will alter existing structural elements unless it is shown on the Drawings or proposed alterations have been approved in writing by the Architect.
4. Structural elements include, but are not limited to, the following: Steel beams and columns, structural masonry walls, reinforced concrete slabs.

D. Coring: All coring shall be performed by the trade requiring the new penetration.

E. New Penetrations in Masonry Construction:

1. Exposed masonry and all masonry bearing walls: All cutting and patching shall be performed under Section 042000 – UNIT MASONRY, with lintels furnished under Section 055000 – METAL FABRICATIONS where required.
2. Concealed portions of non-bearing masonry walls:

a. Small penetrations where no lintel will be required shall be provided under Section 042000 – UNIT MASONRY.

b. Larger penetrations requiring a lintel shall be provided under Section 042000 – UNIT MASONRY, with lintels furnished under Section 055000 – METAL FABRICATIONS.

3. Structural criteria for new openings in masonry walls: Bring the following conditions to the attention of the Structural Engineer for determination of whether a lintel or other reinforcement will be required.

a. Non-load-bearing masonry walls: Any opening wider than one block or 16 inches.
b. Load-bearing masonry walls: Any opening wider than 6 inches.

F. New Penetrations in Non-Masonry Construction:

1. Exposed locations: Cutting and patching shall be provided by the trade(s) responsible for surrounding construction.
2. Concealed locations: Cutting and patching shall be provided by the trade(s) responsible for surrounding construction.
3. Locations at roof: Cutting and patching of roof deck and substrate shall be coordinated with the work of Section 075300 – ELASTOMERIC MEMBRANE ROOFING and Section 075400 – THERMOPLASTIC MEMBRANE ROOFING.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio. Structural elements include but are not limited to the following:

1. Reinforced concrete columns and beams. Coring of concrete foundation walls and slabs will be permitted where shown on drawings or required for mechanical and electrical work.
2. Reinforced masonry bearing walls.
3. Steel columns, beams, joists and connections.

B. 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.

C. 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.

D. 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 Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.6 WARRANTY

A. 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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations. Refer to Section 015000 – Temporary Facilities and Controls for additional requirements.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
2. Cutting of openings in roofs shall be delayed as long as feasible, and preferably until the Roofing Subcontractor is at the site and can provide permanent roof covering immediately. Otherwise, protect roof openings so made in a weather tight manner until permanent roof is installed. Protect existing roofing to remain. Do not damage or alter existing roofing and flashing to remain when doing work under this Section. Refer to Section 015000 – TEMPORARY FACILITIES AND CONTROLS, for additional requirements for protection from the weather.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces, in such a manner as to ensure a minimal difference between the cut area and new materials when patched..
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Use extreme care when cutting through construction containing concealed mechanical and electrical lines. Coordinate cutting and patching work with the following work to be performed under Division 21, 22, 23 and 26 Sections.

    a. Cut off pipe or conduit in walls or partitions to be removed.
    b. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Hazardous Materials: If unanticipated hazardous materials which would be disturbed by cutting and patching are discovered at any time during the course of work, cease work in the affected area only and continue work in other areas, and notify Architect and the Owner of such discovery. Do not proceed with work in such affected areas until written instructions are received.
7. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: 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.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.

3. Restore damaged pipe covering to its original condition.
4. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

5. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

3.4 DEBRIS REMOVAL AND CLEANING

A. Dispose of all materials under Section 017400 – CONSTRUCTION WASTE MANAGEMENT.

B. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

SECTION 017400

CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes administrative and procedural requirements for the following waste handling operations for the Work of the Contractor and all Subcontractors:

1. Salvaging nonhazardous construction and demolition waste.
2. Recycling nonhazardous construction and demolition waste.
3. Disposing of nonhazardous construction and demolition waste.

B. Related Sections include the following:

1. Section 015000 – TEMPORARY FACILITIES AND CONTROLS, for environmental-protection measures during construction.
2. Section 042000 – UNIT MASONRY, for disposal requirements for masonry waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of **25%** percent by weight of total waste generated by the Work.

1.5 SUBMITTALS

A. Waste Management Plan: Submit 3 copies of plan within 7 days of date established for the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include separate reports for demolition and construction waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit three copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. Qualification Data: For Waste Management Coordinator and refrigerant recovery technician.

I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: 5 years minimum experience.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.

6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

E. Forms: Prepare waste management plan on forms included at end of Part 3.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 1 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.

5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Doors and Hardware: Brace open end of doorframes. Except for removing door closers, leave door hardware attached to doors.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Grind asphalt to maximum 1-1/2-inch (38-mm) size.

1. Crush asphaltic concrete paving and screen to comply with requirements in earthwork specification for use as general fill.

B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch (38-mm) size.
2. Crush concrete and screen to comply with requirements in earthwork specification for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 1-1/2-inch (38-mm) size.

a. Crush masonry and screen to comply with requirements in earthwork specification for use as general fill.
b. Crush masonry and screen to comply with requirements in landscape specification for use as mineral mulch.

2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.

J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

K. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

L. Plumbing Fixtures: Separate by type and size.

M. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

N. Lighting Fixtures: Separate lamps by type and protect from breakage.

O. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

P. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.

1. Comply with landscape specification requirements for use of chipped organic waste as organic mulch.

C. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

a. Comply with landscape specification requirements for use of clean sawdust as organic mulch.

D. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

a. Comply with landscape specification requirements for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 017700

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. Final cleaning
2. Temporary and trial usage
3. Warranties and bonds
4. Closeout requirements
5. Inspection and Submittals for Substantial Completion
6. Monetized Punch List Inspections
7. Final Inspection and Submittals
8. Final application and certificate for payment
9. Post-construction inspection

B. Related Work includes, but is not limited to, the following Work under other Sections:

1. Dates for Substantial Completion and Final Completion: Section 002100 – INSTRUCTIONS TO BIDDERS.
2. Procedures related to Architect's additional services if required to complete closeout of Project: Section 011400 – WORK RESTRICTIONS
3. Construction schedule requirements: Section 013200 – CONSTRUCTION PROGRESS DOCUMENTATION.
4. Temporary facilities to be removed at the end of the Project: Section 015000 – TEMPORARY FACILITIES AND CONTROLS.
5. Documents to be submitted as part of Closeout Requirements: Section 017839 – PROJECT RECORD DOCUMENTS
6. Verification of performance of mechanical and electrical systems: Section 018100 – COMMISSIONING.

1.3 SUBMITTALS

A. Warranties and Bonds: As specified herein.

B. Punch Lists: As specified herein.

C. Submittals for Substantial Completion: As specified herein.

D. Final Submittals: As specified herein.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Refer to Section 011400 WORK RESTRICTIONS for cleaning materials.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Before final inspection, thoroughly clean the entire exterior and interior areas of the building where construction work has been performed, the immediate surrounding areas, and corridors, stairs, halls, storage areas, temporary offices, and toilets.

1. Allow adequate time in Construction Schedule to perform thorough final cleaning of entire Project.

B. Refer to Section 011400 WORK RESTRICTIONS for general requirements for cleaning and for cleaning products, and refer to individual specification sections for cleaning requirements for particular products.

C. Employ experienced workmen or professional cleaners for final cleaning operations.

D. Remove all construction facilities, debris, and rubbish from the Owner's property and legally dispose of same beyond site limits.

E. Broom clean exterior paved surfaces, and rake clean other surfaces of the grounds.

F. Sweep, dust, wash, and polish all finished surfaces. This includes cleaning of the Work of all finished trades where needed, whether or not cleaning for such trades is included in their respective Sections.

G. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

H. Leave pipe and duct spaces, chases, and furred spaces thoroughly clean.

I. Wash and polish all new glass on both sides, such Work shall be performed by a contractor specializing in a window cleaning work.

J. Clean all ceilings, wall surfaces, floors, window and door frames, hardware, metal work, glass, glazing, enameled metals, and the like.

K. Repair, patch and touchup marred surfaces to specified finish, to match adjacent surfaces.

L. Each Subcontractor for mechanical and electrical work, including Plumbing, HVAC, Fire Protection, and Electrical Work shall clean materials and equipment for which they are responsible, leaving the Work in a finished and clean state.

M. For each mechanical unit that has been in operation during construction, Contractor shall clean permanent filters and replace disposable filters with new filters as specified for that mechanical unit, and shall also clean ducts, blowers and coils associated with that unit.

N. Prior to final completion, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire Work is clean.

O. Owner will assume responsibility for cleaning as of time designated on Certificate of Substantial Completion for Owner's acceptance of Work or portion thereof.

3.2 TEMPORARY AND TRIAL USAGE

A. Temporary or trial usage by Owner of any mechanical device, machinery, apparatus, equipment, or any Work or materials supplied under the Contract before final completion and written acceptance by the Architect shall not be construed as evidence of acceptance as same.

B. The Owner reserves the privilege of such temporary or trial usage for such reasonable time as required to properly test such item. Claims for damages due to injury to or breaking of any parts of such Work, when the determined cause is weakness or inaccuracy of structural parts, defective material or workmanship, will not be allowed.

C. If the Owner so requests, place an approved person or persons to instruct and assist in such trial usage and bear the costs therefore. Trials shall be made under the Architect's supervision.

3.3 WARRANTIES AND BONDS

A. Compile specified warranties and bonds, review to verify compliance with Contract Documents, and submit to Architect for review and subsequent transmittal, if approved, to the Owner.

B. Assemble two original signed copies of warranties, bonds and service and maintenance contracts executed by Officers of each of the respective manufacturers, suppliers and subcontractors.

C. Neatly type Table of Contents in orderly sequence. Provide complete information for each item:

1. Product or work item identification.
2. Manufacturing or supplying firm, with name of principal, address and telephone number.
3. Scope of work and of warranty provided.
4. Date of beginning of warranty, bond or service and maintenance contract. Commence upon date of Substantial Completion.
5. Duration of warranty, bond or service maintenance contract. (In no case less than one (1) year).
6. Information for Owner's personnel:

    a. Proper procedure in case of failure.
    b. Instances which might affect validity of warranty or bond.

7. Contractor, name of responsible principal, address and telephone number.

D. Form of Submittals: Prepare in duplicate packets and in the following format:

1. Size: 8-1/2" x 11". Punch sheets for 3-ring binder. Z-Fold larger sheets to fit into binders.
2. Cover: Identify each packet with types or printed title "WARRANTIES AND BONDS". List Title of Project, Date and Name of Contractor.
3. Binders: Commercial quality, three-”D”-ring, with durable and cleanable plastic covers.

E. Time of Submittals:

1. For equipment or component parts of equipment put into service during progress of construction, submit documents within ten (10) days after inspection and acceptance. Otherwise, make submittals before Date of Substantial Completion.
2. For items of Work where acceptance is delayed materially beyond the Date of Substantial Completion, provide updated submittal within ten days after acceptance, listing the date of acceptance as the start of the warranty period.

F. Submittals Required: Submit warranties, bond, service and maintenance contracts as specified in the respective Sections of the Specifications.

3.4 CLOSEOUT REQUIREMENTS

A. Punch List: When the Contractor submits a complete list of items to be completed or corrected in accordance with subparagraph 9.8.2 of the GENERAL CONDITIONS and the Architect receives the list, the Architect will make an inspection to determine whether the Work or designated portion is substantially complete. The Contractor shall submit a schedule indicating when each item will be completed.

B. If the Architect determines that the Contractor's list is not complete, the Architect will notify the Contractor. The Contractor shall provide a complete list before the Architect will complete his inspection.

C. If the Architect's inspection discloses any item whether or not included on the Contractor's list, which is not in accordance with the requirements of the Contract Documents, the Architect will add the item to the list and will issue a punch list of items to be completed or corrected before final payment will be made. Such punch list shall not be construed as all-inclusive of the work which the Contractor will be required to perform before final payment.

D. Substantial Completion: Architect will prepare and issue a Certificate of Substantial Completion, AIA G704, complete with signatures of Owner and Contractor, accompanied by list of items to be completed or corrected, as verified and amended by the Architect. Architect will not issue certificates of Substantial Completion until the items listed below in Articles 3.05 and 3.06 have been completed and submitted.

3.5 INSPECTION FOR SUBSTANTIAL COMPLETION

A. In preparation for Substantial Completion, the Contractor shall submit written certification that:

1. Contract Documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.

3. Work has been completed in accordance with Contract Documents.
4. Equipment and systems have been tested in presence of Owner's Representative and are operational.
5. Work is completed, and ready for inspection.

B. Architect will begin inspection within seven (7) days after receipt of above referenced Contractor's Certification.

C. Should the Architect consider the Work is substantially complete in accordance with requirements of Contract Documents, the Architect will request Contractor to make Project Closeout submittals.

D. Should the Architect consider that the Work is not substantially complete:

1. The Architect will notify Contractor, in writing, stating reasons.
2. Contractor shall take immediate steps to remedy the stated deficiencies and send second written notice to the Architect certifying that the Work is complete.

3.6 SUBMITTALS FOR SUBSTANTIAL COMPLETION

A. Contractor shall submit the following items at Substantial Completion:

1. Operating and Maintenance Data.
2. Schedule for training and instruction on new mechanical and electrical systems.
3. Guarantees and Warranties.
4. Keys and keying schedule.
5. Spare Parts and Maintenance Materials.
6. Roofing Guarantee and Flashing Endorsement.
7. Evidence of Compliance with requirements of governing authorities.
8. Punch list with schedule.
9. Final Record Documents

B. Evidence of compliance with authorities' requirements shall include:

1. Certificates of compliance for flame and smoke, and fire rating.
2. Certificates of Inspection:

    a. Mechanical
    b. Electrical

3. Certificate of Occupancy

C. Submit Certificate of Insurance for products and completed operations.

D. Instructions: Instruct Owner's personnel in the operation of all systems, mechanical, electrical and other equipment.

3.7 MONETIZED PUNCHLIST INSPECTIONS

A. Within 30 days of Substantial Completion, the Architect will produce a Monetized Punch List that assigns a monetary value to each item remaining incomplete or incorrect.

B. The Contractor may request two inspections by the Architect after receipt of the Monetized Punch List, for the purpose of documenting progress toward completion of items on the List.

1. If the Architect is required to inspect the Work more than twice prior to establishment of Final Completion, the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to perform additional inspections, until the Work is considered Finally Complete.
2. Refer to Section 011400 WORK RESTRICTIONS, for procedures required in cases where Contractor is responsible for costs for Additional Services of the Architect.

3.8 FINAL INSPECTION

A. The Contractor shall complete or correct all remaining items on the Monetized Punch List in accordance with the time limits stated in the General Conditions.

B. Certification of Final Completion: When the Contractor considers that all of the items on the Monetized Punch List have been completed or corrected, the Contractor shall submit written certification that the items on the Monetized Punch List have been completed and corrected. This certification shall include a copy of the Monetized Punch List with the following information added:

1. Indicate beside each item the date when the item was completed or corrected and,
2. In the case of items completed by subcontractors or sub-subcontractors, the name of the Subcontractor or Sub-subcontractor.

C. The Architect will begin inspection within seven (7) days after receipt of such certification, to determine whether items on the Punch List have been completed.

1. Should the Architect determine that the Work is not complete after receipt of the certification of Final Completion, the Contractor shall be responsible to the Owner for costs for Additional Services of the Architect to perform additional inspections, until all items on the Punch List are completed.
2. Refer to Section 011400 WORK RESTRICTIONS, for procedures required in cases where Contractor is responsible for costs for Additional Services of the Architect.

3.9 FINAL SUBMITTALS

A. Contractor's Affidavit of Payment of Debts and Claims, AIA G706.

B. Contractor's Affidavit of Release of Liens, AIA G706A, with:

1. Consent of Surety to Final Payment: AIA G707.
2. Contractor's release or waiver of liens.
3. Separate releases or waivers of liens for subcontractors, suppliers and others with lien rights against property of Owner, together with list of those parties.

C. All submittals shall be duly executed before delivery to the Architect.

3.10 FINAL APPLICATION AND CERTIFICATE FOR PAYMENT

A. Contractor shall submit final application for payment in accordance with requirements of the GENERAL CONDITIONS.

B. Architect will issue final certificate in accordance with provisions of Conditions of the Contract.

C. Prior to issuance of the Certificate for Final Payment by the Architect, all requirements contained in this Paragraph entitled "Closeout Requirements" and other requirements of the Conditions of the Contract shall be executed, received and approved by the Architect.

3.11 POST-CONSTRUCTION INSPECTION

A. Prior to expiration of one year from Date of Substantial Completion, the Owner's Project Manager will make visual inspection of Work in company with Owner and Contractor to determine whether correction of Work is required, in accordance with provisions of GENERAL CONDITIONS.

B. For guarantees beyond one year, the Owner's Project Manager will make inspection at request of Owner after notification to Contractor.

C. Owner's Project Manager will promptly notify Contractor in writing of any observed deficiencies.

END OF SECTION

SECTION 017839

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. Record prints
2. Final record drawings
3. Operations and maintenance submittals and instructions.

B. Related work includes, but is not limited to, the following work under other Sections:

1. Availability and restriction for use of project electronic files: Section 011400 Work Restrictions.
2. Availability of electronic files for preparation of record documents: Section 011400 Work Restrictions.
3. Surveying and field engineering: Section 013100 Project Management and Coordination.
4. Photographic documentation of construction: Section 013200 Construction Progress Documentation.
5. General requirements for submittals: Section 013300 Submittal Procedures.
6. Other submittals required at the completion of the Work: Section 017700 Closeout Procedures.
7. Documentation required for commissioning: Section 018100 Commissioning.

1.3 DEFINITIONS

A. Record Prints are full sets of black-line or blue-line prints of Contract Drawings, kept at the Project Site and marked regularly to record as-built conditions as specified herein.

B. Final Record Drawings: Reproducible drawings or electronic files prepared from completed and approved Record Prints.

C. Final Record Coordination Drawings: Reproducible drawings or electronic files prepared from updated prints of approved coordination drawings, to record as-built conditions.

1.4 SUBMITTALS

A. Record Prints: Periodic submittal of prints of Drawings marked to indicate Work completed and changes in the Work, as specified in this Section:

1. Record Prints

2. Coordination Drawing Record Prints

B. Final Record Drawings: Reproducible drawings, as specified in this Section:

1. Final Record Drawings
2. Final Record Coordination Drawings

C. Operations and Maintenance Submittals:

1. Maintenance Manuals
2. Schedule of Training and Instruction for mechanical and electrical systems.

PART 2 - PRODUCTS

2.1 RECORD DOCUMENTS, GENERAL

A. The General Contractor shall maintain Record Prints of site plans, landscape drawings, architectural drawings, and structural drawings.

B. Filed Sub-Contractors shall maintain Record Prints of the Work of the following Sections:

1. Section 210000 - Fire Protection.
2. Section 220000 – Plumbing.
3. Section 230000 – Heating, Ventilating, and Air Conditioning.
4. Section 260000 – Electrical Work.

2.2 RECORD PRINTS

A. During the progress of the Work, the General Contractor shall keep on file at all times two (2) complete and separate sets of black line prints of the entire set of Contract Drawings. Each set shall be updated daily to record the following information:

1. Status of Work: One set shall be used to indicate the progress of the Work installed by coloring in the various pipelines, ducts, and apparatus as erected.
2. Revisions: The second set shall be accurately and promptly updated with colored inks, daily as the Work progresses, to accurately record all revisions to the Work, including, but not limited to, the following:

    a. Fire Protection, Plumbing, Heating and Ventilating, and Electrical Work, wherever Work was installed other than as shown on the Contract Drawings or described in the Specifications
    b. Locations, elevations, sizes, etc. of all concealed and buried utilities, ducts, and services, including exterior utility and storm drainage lines.
    c. The General Contractor shall be responsible for assuring that the various revisions are delineated by the specific trades involved.

3. Both sets shall be kept available at all times for use and inspection by the Architect and the Owner.

B. Refer to Section 011400 Work Restrictions for Project Electronic Files to be made available for use by the Contractor in the preparation of Final Record Drawings.

C. Transfer all information from the updated Record Prints to the electronic files at least once every three months.

1. Submit three prints of each updated drawing to the Architect at least three times during construction: when the work is approximately 1/4, 1/2, and 3/4 complete.
2. When roughing in for any particular area is completed, it shall be shown on the Record Prints and a copy submitted for Architect's review.

2.3 FINAL RECORD DRAWINGS

A. Before completion of the Work, and when directed by the Architect, the General Contractor and all indicated subcontractors shall perform the following:

1. Transcribe all previously recorded information from Record Prints onto the electronic files.
2. Make all final changes and corrections to the electronic files for the Final Record Drawings.
3. Signatures Required: The General Contractor or Filed Sub-Contractor shall sign each drawing for which they are responsible, as certification that the work was installed as shown.
4. Deliver signed, completed Final Record Drawings to Architect.

B. Acceptance by the Architect of the completed Final Record Drawings shall be a prerequisite for Substantial Completion.

C. Shop Drawings will not be acceptable as Final Record Drawings for the Project.

D. The Architect shall be the sole judge of the acceptability of Final Record Drawings.

E. Special Requirements for Final Record Drawings of Site Work:

1. Record Drawings for exterior utilities and other items below grade shall include accurate locations of the following:

a. The points where such items enter the building and property lines.
b. All turns, offsets, and other changes in direction below grade.
c. All valves and other appurtenances.

2. Indicate locations of these items using dimensions to adjacent permanent benchmarks or structures as approved by the Architect. Reliance on scale only to locate any temporary or concealed construction will not be acceptable.
3. Final Record Drawings for work below grade shall be submitted immediately upon completion of utility line installation and prior to concealment of the work
4. Refer to Division 2 Sections for additional requirements for Final Record Drawings of site work.

2.4 RECORD COORDINATION DRAWINGS

A. Record progress of the Work and modifications and corrections on a set of prints of approved coordination drawings. Follow procedures as for Record Prints.

B. Final Record Coordination Drawings shall be prepared using information from approved record copies of coordination drawings as for Final Record Drawings.

2.5 MAINTENANCE MANUALS

A. Upon Substantial Completion of the Work, submit maintenance schedules, maintenance manuals, and all approved Shop Drawings, presenting full details for care and maintenance of visible surfaces and all equipment furnished and installed under the Contract.

B. 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 Owner to use, maintain, and service the items properly.

C. Upon Architect's approval of drafts, submit two (2) corrected copies properly bound in a logical and well arranged order, with index, to the Architect for transmittal to the Owner.

PART 3 - EXECUTION

3.1 TRAINING AND INSTRUCTIONS

A. The Contractor shall arrange for instruction for the Owner's employees, to insure proper operation of the equipment furnished.

1. It is the intent of this paragraph to require the Contractor and the applicable Subcontractors to furnish as much detailed instruction as is necessary to educate the Owner’s on-site personnel in the proper use of the equipment.
2. This 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, this may require more than one visit to the Project 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 Owner's employees possess special expertise or have had any previous experience whatsoever in the operation and maintenance of sophisticated mechanical and electrical equipment.
4. Submit the schedule for instructional sessions to the Owner. Do not proceed with instruction until Owner has approved schedule.
5. Refer to specific technical sections for additional requirements specific to particular equipment and systems.

B. 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.

C. Videotape: Instruction sessions and demonstrations shall be video-recorded by professional videographers in DVD format, using tripods, broadcast-quality video cameras and proper lighting. Close-ups of items being demonstrated shall be included. Sound recording shall be clear and perfectly intelligible. Video shall be edited as required to provide a permanent reference. Each session and demonstration shall be included, except where waived by the Architect, and all DVDs shall be properly labeled as to date, subject, and presenter. Provide two (2) copies of each DVD.

END OF SECTION

SECTION 018119

INDOOR AIR QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Work of this Section includes, but is not limited to, requirements for the following procedures:

1. General procedures for maintaining indoor air quality.
2. Selection of products.
3. Mixing of two-component products.
4. Work procedures.
5. Flushout procedures.
6. Integrated pest management.

B. Related work includes, but is not limited to, the following work under other Sections:

1. Scheduling requirements for building flush-out: Section 013200 – Construction Progress Documentation
2. Separate line item for IAQ Control measures in Schedule of Values: Section 012400 – Schedule of Values.
3. Submittal procedures: Section 013300 – Submittal Procedures.
4. Weatherproof enclosures and cleaning materials: Section 015000 - Temporary Facilities and Controls.
5. Sustainable design requirements: Section 018113 – Sustainable Design Requirements.
6. Sealing of air intakes during roofing installation: Section 075400 – Thermoplastic Membrane Roofing.
7. Temporary and permanent filters and other provisions for air handling systems: Division 23 – MECHANICAL.

1.3 INTENT

A. It is the intent of the Owner to maintain a healthful environment for the present and future occupants of the building. Therefore, the Contractor shall conduct the Work in such a way as to avoid creating indoor air quality problems. Required procedures include:

1. Limiting use of products that may contribute to poor indoor air quality.
2. Maintaining work procedures which contain and alleviate dusts and odors and air-borne contaminants.
3. Protection of materials from moisture.

B. The Contractor’s attention is directed to the provisions throughout the Contract Documents intended to maintain indoor air quality during construction and after completion of the Project.

These provisions will be strictly enforced. The Contractor and Filed Sub-Bid Contractors shall notify and require each subcontractor, sub-subcontractor and materials vendor to comply with such provisions.

C. Pest Control Impact on IAQ: With the intent of eliminating or minimizing the use of chemical pesticides, which can become airborne contaminants, the Contractor shall implement an Integrated Pest Management Plan (IPM), consistent with the requirements of the Massachusetts Legislature, Chapter 85 of the Acts of 2000, “An Act Protecting Children and Families from Harmful Pesticides”, and IPM Guidelines issued by the Massachusetts Department of Food and Agriculture Pesticide Bureau.

1. Key aspects of pest control for this Project include:

   a. Construction areas shall be kept clean to minimize residue that will serve as nutrients or harborage for insects and rodents.
   b. No discarded food shall remain on the construction site overnight.
   c. Application of chemical pesticides shall be considered a last resort after other methods have failed, and shall be performed by licensed pest control professionals.
   d. Control of insects shall be performed using traps containing baits and gels.
   e. Control of rodents shall be performed using mechanical traps.
   f. Plant growth will be controlled by hand weeding wherever practical and the use of herbicides will be strictly limited, in accordance with the requirements of landscape Sections.

2. The Contractor shall develop and implement IPM goals and procedures with respect to the control of pests during construction.
3. Refer to specific technical Sections for pest control products and procedures to be incorporated into the Work in compliance with the Owner’s IPM.

1.4 DEFINITIONS

A. “IAQ”: Indoor Air Quality.

B. “MSDS”: Material Safety Data Sheet.

C. “REL”: Reference Established Limit, a highest permissible concentration of a given airborne compound.

D. “VOC”: Volatile Organic Compound.

E. “Work Area”: The portions of the building or site given over to the Contractor for the construction of new Work required by the Contract Documents.

1.5 REFERENCE STANDARDS

A. This Project has been designed to meet the following requirements and regulations. Where different criteria for a given component of the Work are not in agreement, the Contractor shall be required to meet the most restrictive criterion, unless otherwise indicated in the Contract Documents.

1. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE), 1999: ASHRAE Standard 62-1999, Ventilation for acceptable Indoor Air Quality.

2. American Society for the Testing and Materials (ASTM):

    a. ASTM D5116-97, Guide for Small Scale Environmental Chamber Determination of Organic Emissions from Indoor Materials/Products.

3. The Commonwealth of Massachusetts, Department of Labor and Workforce Development, Division of Occupational Safety, Occupational Hygiene Program, 1997: "Preventing Indoor Air Quality Problems During Construction and Renovation."
4. The Commonwealth of Massachusetts, Regulations: Table 310 CMR 7.25.
5. Occupational and Safety and Health Administration (OSHA): Relevant standards on indoor air quality, including the following:

    a. 29 CFR 1926.59, Hazard Communication
    b. 29 CFR 1910.95, Occupational Noise Exposure
    c. 29 CFR 1910.146, Permit Required Confined Spaces
    d. 29 CFR 1910.1000, Air Contaminants
    e. 29 CFR 1910.1200, Hazard Communication.

6. Sheet Metal and Air Conditioning National Association (SMACNA): "IAQ Guidelines for Occupied Buildings under Construction" and "Duct Cleaniliness for New Construction Guidelines."
7. United States Green Building Council, LEED Reference Guide, CURRENT edition.

1.6 PERFORMANCE REQUIREMENTS

A. VOC Emissions: Products have been selected for this Project with respect to their emissions of Volatile Organic Compounds, in order to limit concentrations of VOC's in occupied spaces to levels below the Reference Established Limits established by the State of California.

1. Maximum allowable concentrations of VOC's include the following:

    a. Total VOC's (TVOC):
    b. Formaldehyde: 3 $\mu g/m^3$
    c. Naphthalene: 9 $\mu g/m^3$
    d. Styrene: 300 $\mu g/m^3$
    e. Isocyanurates:
    f. Diesel Exhaust: 5 $\mu g/m^3$

2. Substitutions for any specified VOC-containing product specified will be considered with the condition that acceptable VOC-emission data are available for the proposed product, or the Contractor arranges to have that product tested for VOC emissions by an independent laboratory.

B. Airborne Dust: Dust partitions, site dust control measures and other construction practices shall be maintained to prevent airborne dust from leaving the site or accumulating in the building interior.

C. Moisture: Weather protection, scheduling of the Work, restoration drying techniques using dessicant drying, dehumidification and other construction practices shall be used to maintain the schedule and to prevent construction materials from reaching moisture levels that will support the growth of mold, bacteria and other biological contaminants.

1. Maximum Equivalent Moisture Content (EMC) of substrates installed wet or wetted during the construction process such as concrete, and concrete block shall be measured before

application of mold-sensitive finishes. Installation of the following products shall not proceed until the relative humidity in the substrate does not exceed 70 percent relative Humidity (RH) as measured using ASTM F 2170, or in accordance with the manufacturer's written limitations, whichever is lower:

a. Non-preservative-treated wood products
b. Gypsum wallboard
c. Carpet
d. Acoustical ceiling tile
e. Fabric-covered acoustical panels and tackboards
f. Fixed upholstered seating

2. Wood-based finish products such as flooring, architectural woodwork, casework etc. shall additionally follow the environmental temperature and RH criteria limits established within their respective sections.

1.7 SUBMITTALS

A. General: Prepare submittals for the Work of this Section according to the procedures outlined in Section 01300 – Submittals, modified as required herein. These submittals will be considered informational submittals.

B. For each material that contains VOC's, submit to the Architect five copies of an IAQ Submittal package containing the following information for record purposes. This package shall be submitted separately from the submittals required elsewhere for product review:

1. Description of use of product, including estimated area of exposed surface.
2. Product data.
3. VOC data where applicable:

a. Fluid materials: Indicate content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).
b. Solid materials: Provide VOC emission rates.

4. Material Safety Data Sheet.

C. For construction procedures required to protect Indoor Air Quality, submit the following information for record purposes:

1. Construction Indoor Air Quality Management Plan.
2. Product data for filtration media used during construction and installed at Substantial Completion, highlighting MERV and other performance data.
3. Construction Documentation: Six photographs at three different occasions during construction along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
4. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

D. Evidence of testing of each substrate to receive mold-sensitive finishes in accordance with ASTM F2170.

E. The Contractor's schedule shall include a period for Flush-out procedures as specified herein.

1.8 QUALITY ASSURANCE

A. Construction IAQ Management Plan: The General Contractor shall prepare a plan that complies with SMACNA Guidelines, to address the following issues and other IAQ issues as requested by the Owner:

1. Protection of ventilation system components during construction.
2. Measures designed to limit the presence of VOC's, dust and other contaminants during construction.
3. Procedures for drying out construction moisture
4. Procedures for drying out or otherwise dealing with unanticipated entry of water into new or existing construction.
5. Cleanup of contaminated components during construction and after construction is complete.
6. Provision of temporary ventilation and filters as required during construction.
7. Scheduling of construction activities to comply with IAQ requirements of this Section.

B. Maintain in the Contractor's office a complete and up-to-date notebook of MSDS for all products on-site containing VOC's. Upon the request of the Owner, make the notebook available for review.

C. Pre-testing of construction products to determine VOC emissions:

1. Testing shall conform to the provisions of ASTM D5116-97.
2. The Contractor shall provide pre-testing for the following:

a. Product substitutions proposed by the Contractor.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Throughout the Work, use products, materials which contribute the minimum practicable dust, odors and contaminants to the indoor environment.

B. Products containing Volatile Organic Compounds (VOC's):

1. Comply with the following criteria for VOC limits for the following field-applied products.

a. Adhesives: Refer to Technical Sections which include adhesives, including but not limited to those in Divisions 6 and 9, for specific requirements.
b. Sealants: Refer to Section 079200 – JOINT SEALANTS, and other Technical Sections requiring sealants, for specific requirements.
c. Paints and Coatings: Refer to Section 099000 – PAINTING AND COATING, for specific requirements.

2. No urea formaldehyde-containing products will be permitted for use in this Project.

a. Wood and agrifiber products: Refer to Sections in Division 6 and 12 for products.
b. Insulation: Refer to Section 072100 – THERMAL INSULATION, for products.

3. Where VOC limits are not otherwise specified, use products with maximum VOC content of 7% by volume.

4. Comply with requirements of the specifications for all items containing VOC's.
5. All materials containing VOC's shall be installed no less than fourteen days prior to Owner's occupancy of the building.

C. Indoor Chemical and Pollutant Source Control:

1. Provide temporary walk-off mats to reduce entry of dust, moisture and other contaminants into the building during construction.
2. Refer to Section 124800 – ENTRANCE FLOOR MATS AND FRAMES, for permanent floor grilles to be installed at building entrances. These floor grilles shall be protected from dust, moisture and other contaminants until Substantial Completion.

D. Mechanical Systems and Controls: Refer to Technical Sections in Division 21, 22, 23 and 26 for mechanical and electrical provisions for maintaining Indoor Air Quality.

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES FOR PROTECTING INDOOR AIR QUALITY

A. General: Provide physical barriers, ventilation and other controls as specified to reduce potential for odors, dust, and fumes from affecting present and future occupants of the building, and to meet performance criteria specified herein.

B. Material Transport and Storage:

1. Store construction materials, including ductwork, in clean, dry areas protected from moisture and dust. Refer to Division 2 through 50 Sections for additional on-site storage requirements for individual materials and equipment.
2. No storage of construction materials or debris will be permitted within mechanical rooms.
3. Adsorptive materials shall be protected throughout storage at the site in their original wrapping materials.
4. Keep waste materials that can release dust or odors covered and sealed when on site, and dispose of them promptly.

C. Installation Sequence: Schedule material installation and construction activities so as to avoid adsorption of VOC's and dust into adsorptive materials.

1. Provide protective cover for adsorptive materials that will be subjected to VOC off-gassing and dust.

    a. Wrap adsorptive materials in polyethylene or other impermeable material and seal edges with tape.
    b. Refer to SMACNA Guidelines for minimum requirements.
    c. Protective cover is required for uninstalled materials stored in the construction area, as well as for installed materials.

2. Containers of VOC-containing fluids shall be kept tightly sealed. When not in use, such containers shall be stored in a location remote from adsorptive materials or occupied areas.
3. Apply all wet materials such as paints, coatings and products installed with adhesives, allowing them time to offgas before applying adsorptive or "sink" type products such as.

    a. Acoustical ceiling tiles

b. Carpet
c. Fabric materials, upholstered products or fabric-wrapped panels for use as tackboards or acoustical purposes.

4. Permit carpeting to offgas for 48 hours at the plant prior to wrapping in plastic wrappings. Otherwise, before installation, open up carpet rolls and spread carpet out in an offsite location and ventilate in an area protected from weather, sources of moisture or other VOC's.

D. Regular Cleaning during Construction: Refer to Section 011400 – Work Restrictions, for cleaning provisions. The intent of these documents is to prevent accumulation of contaminant-containing dirt and dust within the building during construction.

1. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
2. Use cleaning methods that minimize airborne dust. Recommended methods include:

a. Immediate removal of spills, excess applications of cleaning products and accumulated water.
b. Increased frequency of cleaning during construction, to maintain surfaces free of dust accumulation.
c. Use of wetting agents and sweeping compounds, and of efficient dust collection equipment such as damp mops and HEPA filtered vacuum cleaners.
d. Refer to SMACNA Guidelines for additional cleaning recommendations.

E. Protection from VOC's from Asphalt- and Solvent-Containing Materials:

1. Sealing of air intakes or ventilation required to prevent waterproofing-generated VOC's from entering HVAC system or occupied areas will be performed under Section 079200 – Joint Sealants.
2. Sealing of air intakes to prevent roofing-generated VOC's from asphalt or adhesives from entering HVAC system shall be performed under Division 07 – Roofing Sections.

3.2 MIXING OF MULTI-COMPONENT PRODUCTS

A. General: Fluid-applied products furnished in two or more components shall be mixed thoroughly, in precise proportions so that an excess of one component will not remain uncured. The requirements of this section apply to all fluid-applied multi-component products, including but not limited to the following:

1. Multi-component adhesives.
2. Multi-component waterproofing and sealant products.
3. Multi-component paints and coatings
4. Multi-component fluid-applied floorings

B. Requirements:

1. All multi-component mixtures shall be brought to the Project Site in factory-sealed and pre-measured containers with precise quantities required for proportional mixing. No bulk materials will be permitted on-site if not packaged in this manner.
2. Mix components in strict accordance wit manufacturer's written instructions regarding quantities, mixing method and other conditions.
3. Each container of each component shall be completely mixed with the entire contents of a corresponding container of the second component.

a. No field mixing of partial quantities will be permitted.
b. Properly dispose of mixed components remaining unused at the end of a workday.

3.3 CONTROL OF COMBUSTION PRODUCTS

A. General: Minimize the use of fuel-burning equipment inside and near the building. Where fuel-burning engines are necessary, cycle off equipment when not in use.

B. Vehicle Exhaust: No vehicles shall be left idling near temporary or permanent air intakes. Motorized vehicles used within the building shall be electrically powered.

C. Power Equipment: No internal combustion engines shall be operated within the building. Location of engines outside the building shall be remote from permanent air intakes and operable windows of occupied spaces.

D. Exhaust of Temporary Heating Equipment:

1. No temporary heating equipment that burns kerosene or other liquid fuel will be permitted within the building.
2. Temporary equipment that produces heat by combustion of fuel shall be installed with provisions to ventilate combustion gases to the exterior of the building.

E. Welding: Welding operations shall be properly ventilated.

F. Smoking: No smoking will be permitted within the construction site or adjacent areas at any time.

3.4 DUST CONTROL

A. General: The following provisions do not supersede specific requirements for methods of construction or applicable general conditions set forth elsewhere in the Contract with regard to performance obligations of the Contractor.

1. Maintain the construction site, stockpiles, access, detour, and haul roads, staging and parking area used for the Work, free of dust that would cause a hazard or a nuisance to those at the site or adjacent sites. Refer to Section 310000 – EARTHWORK, for additional provisions for control of dust on the site.
2. Provide positive methods and apply dust control materials to minimize raising dust from construction operations, and use damp cloths and wetting agents or sweeping compounds to prevent air-borne dust from dispersing into the atmosphere.
3. Cutting of concrete and masonry products shall be performed using wet saw methods.
4. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
5. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
6. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces, including paint, coatings, sealants, caulking, adhesives.

B. Dust Partitions and Coverings:

1. Furnish, erect, and maintain for the duration of the work period, temporary fire-resistant dust-proof coverings and solid partitions as required to prevent the spread of dust beyond the immediate area where work is being performed.

2. Temporary partitions for dust control shall extend from floor to bottom of structure above, to provide an air-tight barrier. Provide air-tight coverings for openings required for access through partitions.
3. Cover equipment installed within construction area using canvas, polyethylene and tape, or other materials as recommended by manufacturer of equipment for protection from airborne dust and vapors.
4. Refer to Section 015000 – Temporary Facilities and Controls, for additional requirements for temporary partitions and related protective measures.

C. Prevent dust and odors from entering the new HVAC system. Confirm that the HVAC Subcontractor has sealed all diffusers, return side ductwork and equipment within the Work Area so as to prevent dust from entering. For further requirements, refer to SMACNA Guidelines and DIVISION 23 – Heating, Ventilating and Air Conditioning.

D. Prevent exterior dust and odors from entering interior space after building is enclosed. Whenever possible, seal window units with plastic as recommended in SMACNA Guidelines.

3.5 WATER DAMAGE

A. General: The General Contractor shall be responsible for protecting the Work from moisture, in order to prevent growth of harmful fungus, mold and other biological activity.

B. Protection of Existing and New Building Construction:

1. Refer to Section 015000 – Temporary Facilities and Controls, for materials and installation of weatherproof enclosures.
2. Remove and replace construction which becomes wet, or which shows evidence of biological growth due to the presence of moisture.

C. Protection of Stored Construction Materials:

1. Take precautions to prevent porous materials such as gypsum board, insulation, ceiling tile, wood and similar products from becoming wet.
2. Refer to Section 015000 – Temporary Facilities and Controls, for materials and installation of weatherproof enclosures.
3. Store materials above ground surfaces and provide spacers between ground and protective covering to allow for ventilation
4. Discard construction material which becomes wet, or which shows evidence of biological growth due to the presence of moisture.

D. Procedures for drying out wet construction: In the case that an unanticipated event permits the entry of water into new or existing construction, the Contractor shall perform procedures to dry out construction within 24 hours, to a degree that will not support biological growth using restoration drying techniques.

1. Refer to guidelines published by the United States Environmental Protection Agency.
2. Construction that is not adequately dried out, or which shows evidence of biological growth, shall be removed immediately from the construction area and disposed of legally.
3. Wetting by contaminated water and subsequent cleaning and decontamination shall be supervised by a qualified company.

3.6 CLEAN UP

A. Prior to turning over work area to Owner, conduct final cleaning to remove dust to the minimum practicable level.

B. Clean ductwork, registers and grilles within the Work Area, and HVAC equipment servicing the Work Area using professional duct cleaning company.

C. After completion of duct cleaning, vacuum vertical and horizontal surfaces, ledges, trim, tops of light fixtures and other equipment, and other locations where dust has settled. Utilize HEPA filtered vacuum to capture fine dust.

D. Vacuum carpet tiles and fabric-covered surfaces with a high-efficiency particulate arrestor (HEPA) vacuum prior to Substantial Completion.

E. Do not use solvent-based cleaners in final cleaning of Work Area, unless cleaning occurs at least 14 days prior to Owner's scheduled Active Use of the area.

F. Coils, air filters and fans in HVAC system shall be cleaned prior to final testing and balancing. Refer to Division 23 – HVAC, for requirements.

3.7 SCHEDULED FLUSHOUT PROCEDURES

A. General:

1. Schedule Building Flush-Out prior to testing and balancing of mechanical systems, as outlined in Section 013200 – CONSTRUCTION PROGRESS DOCUMENTATION.
2. No mechanical system start-up will be permitted until application of major finishes, installation of casework and final cleanup is complete.

B. Building Flush-Out: Ventilate entire building with 100 percent outside air for a period of 28 calendar days. Refer to Division 23 Sections for requirements for filters, static pressure sensors, start-up and operation of mechanical systems.

C. Exterior Conditions for Flush-Out:

1. Remove potential sources of pollution from proximity to air intakes. Pollutant sources include but are not limited to: waste materials, temporary fuel-burning equipment, vehicles, dust-producing activities.
2. Control dust on the building site by spraying exposed soil with water and encouraging growth of permanent grass and other plant materials.
3. If unavoidable pollutant-generating activities occur outside the building during the flush-out period, seal building as recommended in SMACNA Guidelines, and discontinue flush-out until such activities cease.

D. Equipment Requirements During Flush-Out Period:

1. Temporary MERV 10 filters shall be in place before HVAC system start-up.
2. Windows shall be securely closed.
3. Disable carbon dioxide monitors.
4. Maintain normal room temperature.
5. Monitor filter pressure drop for each HVAC unit that contains filters, and replace filters if needed due to accumulation of particulate matter before the end of the period.

E. Replace temporary filters with new MERV 10 filters at completion of building flush-out.

3.8 INDOOR AIR QUALITY FIELD TESTING

A. Indoor Air Quality Testing, General:

1. The Owner reserves the right to conduct indoor air quality testing before, during and after construction, in order to quantify the effects of the Contractor's Indoor Air Quality Plan and verify that the Indoor Air Quality provisions of the Contract Documents are being met.
2. The Contractor shall cooperate with the Owner in scheduling the testing and providing access to the site.

END OF SECTION

SECTION 024100

DEMOLITION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included:

1. Demolition and removal of selected portions of buildings and structures and as required for new work. Refer to the Drawings for additional requirements.
2. Demolition and removal of selected site elements and as required for new work. Refer to the Drawings for additional requirements.
3. Salvage of existing items to be reused or turned over to the facility.
4. Removal and legal disposal of demolished materials off site. Except those items specifically designated to be relocated, reused, or turned over to the facility, all existing removed materials, items, trash and debris shall become property of the Contractor and shall be completely removed from the site and legally disposed of at their expense. Salvage value belongs to the Contractor. On-site sale of materials is not permitted.
5. Maintenance, watering and care of trees designated to remain by a certified arborist during the construction period.
6. Demolition and removal work shall properly prepare for alteration work and new construction to be provided under the Contract.
7. Scheduling and sequencing operations without interruption to utilities serving occupied areas. If interruption is required, obtain written permission from the utility company and the Owner.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 011000 - GENERAL REQUIREMENTS for temporary facilities and controls, for maintenance of access, for cleaning during construction, and for dust and noise control.
2. Section 017400 - CONSTRUCTION WASTE MANAGEMENT for waste management and recycling.
3. Section 018120 - CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT for indoor air quality control procedures.
4. Division 21 - FIRE PROTECTION:

    a. Disconnecting, capping and otherwise making inactive existing fire protection services in areas where demolition and removal work is required.
    b. Disconnect and reinstallation of fire protection equipment temporarily interrupted during construction.

5. Division 22 - PLUMBING:

a. Disconnecting, capping and otherwise making inactive existing plumbing services in areas where demolition and removal work is required.
b. Disconnection and reinstallation of plumbing equipment temporarily interrupted during construction.

6. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING:

a. Disconnecting, capping and otherwise making inactive existing HVAC services in areas where demolition and removal work is required.
b. Disconnect and reinstallation of HVAC equipment temporarily interrupted during construction.

7. Division 26 - ELECTRICAL WORK:

a. Disconnecting, capping and otherwise making inactive existing electrical services in areas where demolition and removal work is required.
b. Disconnect and reinstallation of electrical equipment temporarily interrupted during construction.

8. Section 311000 – SITE CLEARING:

a. Excavating and removal of existing pavement, sub-surface building and utility structures and lines, appurtenances, and other elements indicated on the Drawings.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to the Owner ready for reuse, at a location designated by the Owner. Protect from weather until accepted by Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated. Protect from weather until reinstallation.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain property of the Owner as applicable. Carefully remove each item or object in a manner to prevent damage and deliver promptly to a location acceptable to the Owner.

1.5 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with early and late starting and finishing dates for each activity. Ensure Owner's on-site operations are uninterrupted if applicable.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust- and noise-control temporary partitions and means of egress, including for other occupants affected by selective demolition operations.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged, and turned over the Owner.

C. Predemolition Video and Pictures: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 requirements. Submit before Work begins.

1.6 QUALITY ASSURANCE

A. Examination of Existing Conditions: The Contractor shall examine the Contract Drawings for demolition and removal requirements and provisions for new work. Verify all existing conditions and dimensions before commencing work. The Contractor shall visit the site and examine the existing conditions as he finds them and shall inform herself/himself of the character, extent and type of demolition and removal work to be performed. Submit any questions regarding the extent and character of the demolition and removal work in the manner and within the time period established for receipt of such questions during the bidding period.

B. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Section 011000 - GENERAL REQUIREMENTS, Project Meetings. Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 SALVAGING

A. Salvaged for Reinstallation: Materials indicated on the Drawings to be salvaged and reinstalled shall be carefully removed and stored at a location acceptable to the Architect and Owner.

B. Salvaged for Storage: Materials indicated on the Drawings or designated in the field by the Owner to be salvaged and stored shall be carefully removed and delivered to the Owner at locations determined by Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer registered in the state that the project is located to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction videotapes.

1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies and Owner.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.
4. Prior to commencing cutting work in existing surfaces, take all precautionary measures to assure that mechanical and electrical services to the particular area have been made inactive. Coordinate with Fire Suppression, Plumbing, HVAC, and Electrical subcontractors. Only licensed tradesmen of that particular trade shall disconnect and cap existing mechanical and electrical items that are to be removed, abandoned and/or relocated.
5. If, during the process of cutting work, existing utility lines are encountered which are not indicated on the Drawings, regardless of their condition, immediately report such items to the Architect. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 011000 - GENERAL REQUIREMENTS, Temporary Facilities and Controls.
2. Maintain adequate passage to and from all exits at all times. Before any work is done which significantly alters access or egress patterns, consult with the Architect and obtain approval of code required egress. Under no condition block or interfere with the free flow of people at legally required exits, or in any way alter the required condition of such exits.

B. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
2. Remove temporary shoring, bracing and structural supports when no longer required.
3. Post warning signs and place barricades as applicable during placement and removal of temporary shoring.

C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area(s).

1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction. Provide temporary barricades as required to limit access to demolition areas.
2. Protect existing site improvements, appurtenances, and landscaping to remain.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Maintain clear unimpeded passage through the work area for safety and emergency egress.
10. Saw cut overruns in concrete and masonry for new door, window and other finish openings is not permitted. Core drill corners and finish square to match required opening.
11. Dispose of demolished items and materials promptly.

    a. Comply with requirements in Section 017400 - CONSTRUCTION WASTE MANAGEMENT.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by the Owner.
5. Protect items from damage during transport and storage.

C. Removed Items for Reinstallation by the Respective Trade.

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by the Owner.
5. Protect items from damage during transport and storage.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

E. Items for Re-use and Preservation of Existing Surfaces to Remain:

1. The Contractor shall inspect closely each item specifically designated to be relocated, re-used, or turned over to the Owner prior to its removal, and immediately report damages and defects to the Architect and the Owner. The Contractor shall be responsible for any subsequent damage to the same other than latent defects not readily apparent from close inspection, and shall bear responsibility for its repair or same replacement as directed by the Architect, to the satisfaction of the Owner.
2. Unless special surface preparation is specified under other Specification Sections, leave existing surfaces that are to remain in a condition suitable to receive new materials and/or finishes.

3.5 PROTECTION OF PUBLIC AND PROPERTY

A. Provide all measures required by federal, state and municipal laws, regulations, and ordinances for the protection of surrounding property, the public, workmen, and Owner's employees during all demolition and removal operations. Measures are to be taken, but not limited to installation of sidewalks, sheds, barricades, fences, warning lights and signs, trash chutes and temporary lighting.

B. Protect all walks, roads, streets, curbs, pavements, trees and plantings, on and off premises, and bear all costs for correcting such damage as directed by the Architect, and to the satisfaction of the Owner.

C. Demolition shall be performed in such a manner that will insure the safety of adjacent property. Protect adjacent property from damage and protect persons occupying adjacent property from injuries which might occur from falling debris or other cause and so as not to cause interference with the use of other portions of the building, of adjacent buildings or the free access and safe passage to and from the same.

D. Every precaution shall be taken to protect against movement or settlement of the building, of adjacent buildings, sidewalks, roads, streets, curbs and pavements. Provide and place at the Contractor's own expense, all necessary bracing and shoring in connection with demolition and removal work.

E. Remove portions of structures with care by using tools and methods that will not transfer heavy shocks to existing and adjacent building structures, both internal and external of the particular work area.

F. Provide and maintain in proper condition, suitable fire resistive dust barriers around areas where interior demolition and removal work is in progress. Dust barriers shall prevent the dust migration to adjacent areas. Remove dust barriers upon completion of major demolition and removal in the particular work area.

3.6 DISCOVERY OF HAZARDOUS MATERIALS

A. If hazardous materials, such as chemicals, asbestos-containing materials, or other hazardous materials are discovered during the course of the work, cease work in affected area only and immediately notify the Architect and the Owner of such discovery. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

B. If unmarked containers are discovered during the course of the work, cease work in the affected area only and immediately notify the Architect and the Owner of such discovery. Do not proceed with work in such areas until instructions are issued by the Architect. Take immediate precautions to prohibit endangering the containers integrity. Continue work in other areas.

3.7 CUTTING

A. Perform all cutting of existing surfaces in a manner which will ensure a minimal difference between the cut area and new materials when patched. Use extreme care when cutting existing surfaces containing concealed utility lines which are indicated to remain and bear full responsibility for repairing or replacement of all such utilities that are accidentally damaged.

B. Provide a flush saw cut edge where pavement, curb and concrete removals abut new construction work or existing surfaces to remain undisturbed.

C. All slurry and water shall be contained and managed to avoid damage to existing conditions when using a wet saw or wet core driller.

D. Obtain and pay for a hot work permit and arrange to have on-site a Fire Watch when using a cutting torch or similar item.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Comply with requirements of Section 017400 - CONSTRUCTION WASTE MANAGEMENT and the following:

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Premises shall be left in a clean condition and ready to accept alteration work and new construction.

END OF SECTION

SECTION 031100

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. This section specifies requirements for concrete formwork to produce cast-in-place concrete structures as shown on the Drawings and as specified herein. The work shall consist of designing, furnishing, constructing, and removing formwork for all cast-in-place concrete structures.

B. Use forms, wherever necessary, to confine the concrete and shape it to the required lines, and to provide the specified finish. Construct forms with sufficient strength to structurally support the work and withstand the pressure resulting from placement and vibration of the concrete, and maintain forms rigidly in position. Construct forms sufficiently tight to prevent loss of mortar from the concrete.

1.3 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117: Standard Specification for Tolerances for Concrete Construction and Materials.
2. ACI 301: Standard Specification for Structural Concrete.
3. ACI 347: Guide to Formwork for Concrete.

B. Massachusetts State Building Code.

1.4 DESIGN REQUIREMENTS

A. Design formwork to support vertical loads and lateral pressures resulting from placement and vibration of concrete in accordance with the requirements of ACI 301 and ACI 347, and as specified herein.

B. Camber the formwork to compensate for anticipated deflections due to the weight and pressure of the fresh concrete and due to construction loads.

C. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Use wedges or jacks, individually or in combination for adjustment.

D. Design forms and falsework to include assumed values of live loads, dead load, weight of moving equipment operated on formwork, concrete mix, height of drop, vibrator frequency, ambient temperature, lateral stability, and other factors pertinent to the safety of the structure during construction.

E. Provide and design forms to conform with expansion and construction joint locations.

1.5 SUBMITTALS

A. Submittals for the following items shall be made in accordance with the requirements as specified. Refer to Section 01 33 00 SUBMITTAL PROCEDURES for provisions and procedures.

B. Submit the following at least 30 days before the first concrete placement:

1. Manufacturer's data and installation instructions for proprietary form accessories, form coatings, pipe sleeves and seals, form ties and manufactured form systems if used.
2. Certification that form coatings comply with the requirements of this Section.

1.6 QUALITY ASSURANCE

A. Provide in accordance with the requirements as specified.

B. Tolerances:

1. Permissible surface irregularities for the various classes of concrete surface finish as specified in Section 033000, Cast-in-Place Concrete, are defined as "finishes", and are to be distinguished from tolerances as specified herein. Deviations from the established lines, grades, and dimensions will be permitted to the extent set forth herein.
2. The tolerance limits specified in this Section and the surface finish irregularities permitted in Section 033000, Cast-in-Place Concrete, are not the limits to which forms may be built or by which damaged from sheathing may be used. These limits are provided only for the occasional slight misalignment or irregularity of surface, which may occur despite a serious effort to build and maintain the forms accurately and securely with an even surface. These limits will be allowed only for inadvertent or relatively infrequent irregularities of the degree mentioned, but practices and form materials will be prohibited which without doubt will result in the creation of additional irregularities, even though these would be within the limits specified.
3. Where specific tolerances are not stated herein or shown on the Drawings for a structure, portion of a structure, or other feature of the work, permissible deviations will be interpreted conforming to the tolerances stated herein for similar construction. Specific maximum or minimum tolerances as shown on the Drawings in connection with any dimension shall be considered as supplemental to the tolerances specified herein and shall govern. Concrete forms shall be set and maintained within the tolerance limits necessary to ensure that the completed work will be within the tolerances specified. Concrete construction that exceeds the tolerance limits specified or as shown on the Drawings shall be remedied or removed and replaced by the Contractor at no cost to the Owner.
4. Tolerances shall be as specified in ACI 117, Standard Specifications for Tolerances for Concrete and Materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms for Exposed Finish Concrete: Construct formwork for exposed concrete surfaces with smooth faced undamaged plywood or metal, metal-framed plywood faced or other acceptable panel-type facing materials approved by Engineer, to provide continuous, straight, smooth as-

cast surfaces, and produce a uniform and consistent texture and pattern on the surfaces. Metal patches on forms for these surfaces will not be permitted. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on the drawings.

1. Use overlaid plywood complying with U.S. Product PS-1 “A-C or B-B High Density Overlaid Concrete Form”, Class I.
2. Use plywood complying with U.S. Product Standard PS-1 “B-B (Concrete Form) Plywood”, Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Tubular Fiber Forms:

1. Provide forms with spirally constructed laminated plies of fiber.
2. Provide forms with wall thickness as recommended by the manufacturer to meet load requirements of the various uses and sizes.
3. Provide forms with wax coated outside surfaces for moisture resistance.
4. Provide forms with inside surface coated with bond-breaker compound.

D. Form Ties:

1. Form Ties: For concrete structures, which will not be in view or buried below finish grade, use carbon steel factory-fabricated, removable or stay in place snap-off type form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units, which will leave no metal closer than 1-1/2” to surface. Provide ties which, when removed, will leave holes not larger than 1” diameter in concrete surface. Patch all holes with non-shrink grout.
2. Form ties and spreaders for walls in areas exposed to view shall be Stainless Steel Cone–Tight Tyscru by Richmond Screw Anchor Co.; Dayton Sure-Grip and Shore Co.; or substitute approved by Engineer with Plastic cone-tight type cones having a 1” setback and a taper from 1” to 1-1/4”. Tyscru cone holes shall be sealed with plastic set back plugs, color as selected by Engineer from manufacturer’s standard color selection or filled with non-shrink grout. Tyscru ties shall be sized to satisfy loading requirements.
3. In lieu of form ties specified above, fiberglass form tie systems shall be used. Fiberglass form ties shall be standard gray color. The concrete structure shall be finished by grinding the fiberglass form tie flush with the finish surface of the concrete structure.

    a. If tapered architectural holes are required, dummy tapered cones having a 1” setback and a taper from 1” to 1-1/4 shall be fastened to the interior of the formwork to achieve the specified pattern on the finish structure.

E. Form Releasing Agents: Provide commercial formulation form-releasing agents that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds. Volatile organic compound emissions of form coating agent shall not exceed 2.09 pounds per gallon (250 grams per liter).

F. Chamfer Strips: Provide 1-inch triangular fillets, unless noted otherwise on drawings, to form all exposed concrete corners. Material shall be rubber or polyvinyl chloride type, or smooth clear, sealed softwood.

PART 3 - EXECUTION

3.1 INSPECTIONS

A. Examine the substrate and conditions under which work of this Section is to be performed, and correct unsatisfactory conditions, which would prevent proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FORM CONSTRUCTION

A. General:

1. Construct forms as designed and in accordance with Contractor's approved working drawings conforming to ACI 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, level, and plumb work in finished structures.
2. Provide for openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required. Use selected materials to obtain required finishes.
3. Forms for concrete which accommodate work of other trades, fabricated before the opportunity exists to verify the measurements of adjacent construction, shall be accurately sized and located as dimensioned on the Drawings. In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions as approved by the Engineer, at no cost to the Owner.

B. Fabrication:

1. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage concrete surfaces.
2. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to temporary openings on forms in as many inconspicuous locations as possible, commensurate with design requirements. Form intersecting planes to provide true, clean cut corners.

C. Falsework:

1. Erect falsework and support, brace, and maintain it to safely support vertical, lateral, and asymmetrical loads applied until complete structure has attained design strength. Construct falsework so that adjustments can be made for take-up and settlement, and access is provided for inspection.
2. Provide wedges, jacks or chamfer strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to product work of required dimensions.

D. Forms for Exposed Concrete:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes
2. Provide sharp clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or grits to maintain true, square intersections.

3. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material, which will produce bow.

E. Corner Treatment:

1. Unless shown otherwise, form chamfers with 1-inch by 1-inch strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete. Extend terminal edges to required limits and miter chamfer strips at changes in direction.

F. Control Joints: Locate as indicated on the Drawings.

G. Provision for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Verify size and location of openings, recesses and sleeves with the trade requiring such items. Accurately place and securely support items to be built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove encrusted mortar and grout, chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.3 FORM COATINGS

A. Coat form contact surfaces with form-releasing agent before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces that will be bonded to fresh concrete. Apply in strict compliance with manufacturer's instructions.

B. Remove surplus coating on form surfaces before placing concrete.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into the forms, anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

B. Set edge forms or bulkheads and intermediate screed strips for slabs, to obtain required elevation and contours in the finished slab surface. Provide and secure units to support types of screeds required.

3.5 REMOVAL OF FORMS

A. Formwork not supporting concrete, such as sides of walls, columns, and similar parts of the Work, may be removed after cumulatively curing at not less than 50 degrees F for 72 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as elevated beams, joists, slabs and other structural elements may not be removed until concrete has attained 70% of its design minimum 28-day compressive strength and has cumulatively cured for no less than 7 days. Concrete shall have sufficient strength to safely support its own weight and construction live loads and lateral pressures. Determine potential compressive strength of in-place concrete testing field-

cured specimens representative of the concrete location or members, as specified in Section 033000, Cast-in-Place Concrete.

C. Form facing material may be removed one day after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

D. Form ties: The concrete structure shall be finished by grinding the fiberglass form ties flush with the finish surface of the concrete structure.

3.6 REUSE OF FORMS

A. 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. When forms are reused for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Apply new form releasing agent to all form areas that will be in contact with concrete.

B. Do not reuse forms if there is any evidence of surface wear and tear, splits, fraying, delamination or other damage which would impair the quality of the concrete surface or prevent obtaining the specified concrete finish.

END OF SECTION

SECTION 031510

CONCRETE CONTROL, CONSTRUCTION, AND EXPANSION JOINTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. Section includes: All work necessary to provide construction joints, expansion joints, and control joints in structural or plain concrete as indicated and specified.

1.3 REFERENCES

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

1. C 920: Specification for Elastomeric Joint Sealants.
2. C1193: Guide for Use of Joint Sealants.
3. D1751: Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
4. D1752: Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with the requirements as specified in Section 013300, SUBMITTAL PROCEDURES.

1. Manufacture’s printed data and literature for all specified materials and locations where materials are to be used.
2. Manufacturer’s printed instruction for:

    a. Treatment of cut surfaces of premolded expansion joint filler.
    b. Preparation of concrete for joint sealant.

B. Samples of joint fillers.

C. Color samples or charts for joint sealants.

1.5 QUALITY ASSURANCE

A. Provide in accordance with the requirements as specified in Section 014500, QUALITY CONTROL.

B. Do not omit control, construction, or expansion joints.

C. Do not add or relocate control, construction, or expansion joints without written authorization from the Engineer.

D. Cast slabs and beams monolithically without horizontal joints.

E. Do not use horizontal joints within foundation mats, base slabs, footings, pile caps, slabs on grade or elevated beams and slabs.

F. Provide control, construction, and expansion joints in concrete fills and toppings at the same location as the control, construction and expansion joints in the supporting concrete.

G. Reject material exceeding expiration date for use.

H. Insure that concrete surfaces to receive joint sealant are cleaned in accordance with the printed instructions of the joint sealant manufacture.

1.6 DELIVERY AND STORAGE

A. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.

B. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.

C. Store joint sealants in a dry warm location to prevent freezing.

D. Store plastic products under cover in a dry cool location, out of direct sunlight.

PART 2 - PRODUCTS

2.1 PREMOLDED JOINT FILLER

A. Provide premolded–joint filler conforming to ASTM D1752, Type I or Type II.

B. Provide Type III self-expanding cork where specifically indicated.

C. Provide joint filler of same thickness as expansion joint width indicated.

D. Provide maximum length filler manufactured to minimize field splicing.

2.2 JOINT SEALANT

A. Horizontal Expansion and Construction Joints: Provide one-component, self-leveling, polyurethane-base joint sealant for expansion joints in horizontal surfaces and surfaces inclined less than 30 degrees from the horizontal. Acceptable products:

1. Sikaflex-1CSL by Sika Corporation
2. Approved equivalent.

B. Provide joint sealant for expansion joints in walls and surfaces inclined greater than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade NS, Class 25.

C. Horizontal Control Joints: Provide 2-component, self-leveling 100% solids, flexible, control joint resin. Acceptable products:

1. Sikadur 51 SL by Sika Corporation

2. Approved equivalent.

D. Provide compatible joint sealants as recommended by manufacturer when they abut each other.

E. Provide sealant intended for continuous submergence in liquid containing structures.

2.3 BOND BREAKER FOR JOINT SEALANTS

A. Provide polyethylene tape, coated tape or metal foil.

2.4 BACK-UP MATERIAL FOR JOINT SEALANTS

A. Provide polyethylene foam or polychloroprene foam rubber.

B. Do not use material impregnated with oil, bitumen or similar substances.

C. Provide back-up material as recommended by joint sealant manufacturer that is compatible with the joint sealant and has the same expansion/contraction capability as joint sealant.

PART 3 - EXECUTION

3.1 CONSTRUCTION JOINTS

A. Locate and install construction joints as indicated or, if not indicated, locate so as not to impair the strength and appearance of the structure. Submit proposed construction joint locations for approval.

B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints.

C. Key groove all construction joints unless otherwise indicated. Wall horizontal joints need not be keyed except where specifically indicated.

D. Key grooves shall be one-third the thickness of the thinner member and 1-1/2-in. deep unless otherwise indicated.

E. Use tapered key groove forms to permit form removal without damage to the groove. Taper not to exceed 2 inches per foot.

F. Center waterstops in construction joints unless otherwise indicated. Secure waterstops in position by tie wire to adjacent reinforcing every 12 inches.

G. Consolidate concrete during placement in the vicinity of key groove without damaging or dislodging waterstop.

H. Remove all key groove forms.

I. Clean key groove of laitance, curing sealant, foreign materials and protrusions of hardened concrete. Roughen by bush hammer or lightly sandblast to expose coarse aggregate. Blow out debris and dust with oil-free compressed air.

J. Protect exposed key groove and waterstop from damage.

3.2 EXPANSION JOINTS

A. Install expansion joints in accordance with the manufacturers printed instructions and as indicated.

B. Center waterstops in expansion joints unless otherwise indicated. Secure waterstops in position by tie wire to adjacent reinforcing every 12 inches.

C. Consolidate concrete during placement in vicinity of expansion joint without damaging premolded joint filler and waterstop.

D. Prepare joint to receive sealant by sand-blasting then blowing out the joint with clean, dry, compressed air.

3.3 PREMOLDED JOINT FILLER

A. Treat cut surface of premolded joint filler in conformance with manufacturer's printed instructions.

B. Place premolded joint filler against the bulkhead form and fasten to the inside of the form with noncorrosive fasteners. Remove all fasteners when bulkhead form is removed.

C. Prevent disturbance of or damage to premolded joint filler.

D. Fill expansion joint completely with premolded joint filler, except as specified below.

E. Secure wood strips to expansion joint surfaces, which are to receive joint sealant.

F. Use tapered wood strips with the smaller width being the same width as the expansion joint and of depth necessary to install the joint sealant and back-up materials.

G. Use materials to secure the premolded joint filler and wood strips that will not harm concrete or affect the joint sealant bond to concrete.

H. Do not remove wood strips until forms are removed as specified in the Concrete Formwork section.

I. Clean groove of laitance, curing sealant, foreign materials and protrusions of hardened concrete. Blow out debris and dust with oil-free compressed air.

3.4 CONTROL JOINTS

A. Saw-cut control joints at locations indicated on the Drawings or at locations approved by the Engineer of Record if not shown on the Drawings.

B. Saw cut joints to ¼ of the depth of the slab or concrete member immediately after slab finishing.

C. All control joints shall be made within 8 hours of concrete placement.

D. Prepare all control joints to receive sealant by high-pressure washing after saw-cutting, sandblasting after the joints are dry, and then blowing out the joints with clean, dry, compressed air.

3.5 JOINT SEALING

A. Seal the dry clean concrete in joints in conformance with manufacturer's printed instruction.

B. Install back-up and bond breaker materials where required or recommended by the manufacturer.

C. Prime concrete, fill flush with joint sealant to required thickness, tool to concave shape and seal in conformance with manufacturer's printed instructions and ASTM C1193.

D. Prevent spilling joint sealant over adjoining surfaces. Use tape adjacent to joint as required. Remove all tape completely from concrete surface after installing joint.

E. Do not prime concrete or install joint sealant when sealant, air or concrete temperature is less than 40 deg. F. or as required by manufacturer.

END OF SECTION

SECTION 031515

POLYVINYL CHLORIDE WATERSTOPS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. Provide polyvinyl chloride waterstops as indicated and specified.

1.3 REFERENCES

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

1. D570: Test Method for Water Absorption of Plastics
2. D624: Test Method for Shear Strength of Conventional Vulcanized Rubber Thermoplastic Elastomers
3. D638: Test Method for Tensile Properties of Plastic
4. D746: Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
5. D747: Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
6. D1149: Test Method for Rubber Deterioration – Surface Ozone Cracking in a Chamber
7. D1203: Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods
8. D2240: Test Method for Rubber Property – Durometer Hardness

B. Corps of Engineers Specification CRD-C572: Specification for Polyvinyl Chloride Waterstop.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with requirements as specified in Section 013300, SUBMITTAL PROCEDURES.

1. Manufacturer’s printed data and literature for all specified materials and locations where materials are to be used.

B. Samples of waterstops.

C. Certification that materials proposed for use is non-toxic and has no effect on the quality or appearance of potable water.

1.5 QUALITY CONTROL

A. Provide in accordance with the requirements as specified in Section 014500, QUALITY CONTROL.

B. Reject waterstops containing scrap or reclaimed material or pigment.

C. Require a manufacture's service representative to visit the job site before any waterstops are installed to demonstrate the correct installation and splicing procedures.

D. Correctly position waterstops in construction and expansion joints.

E. Spark test waterstop splices before installation.

F. Use factory made and tested crosses, tees and ells at corners and intersections.

1.6 DELIVERY, STORAGE AND HANDLING

A. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.

B. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.

C. Store plastic products under cover in a dry cool location, out of direct sunlight.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE WATERSTOP

A. Provide polyvinyl chloride waterstops conforming to Corps of Engineers Specification CRD-C572.

B. Provide waterstops manufactured from virgin polyvinyl chloride plastic compound has a minimum tensile strength of 1750 psi.

C. Provide waterstops of type, shape and size indicated with looped galvanized steel wire along both edges.

1. 9 in. waterstops shall be center bulb ribbed type.
2. 6 in. waterstops shall be center bulb ribbed type.

D. Provide factory-made and spark tested crosses, tees and ells fabricated by the waterstop manufactured using thermostatically controlled electric heat source.

E. Provide waterstops which meet or exceed the criteria in Table 03255-1.

TABLE 03255-1

Property	Test Method	Limit
Water Absorption	ASTM D 570	0.15% maximum
Tear Resistance	ASTM D 624	300 #/inch minimum
Ultimate Elongation	ASTM D 638	300% minimum
Tensile Strength	ASTM D 638	2000 psi minimum
Low Temperature Brittleness	ASTM D 746	No Failure at -35°F
Stiffness in Flexure	ASTM D 747	600 psi minimum
Specific Gravity	ASTM D792	1.38 +/- 0.05
Ozone Resistance	ASTM D 1149	No Failure
Volatile Loss	ASTM D 1203	0.50% maximum
Hardness, Shore A	ASTM D 2240	70 to 85

Property	Test Method	Limit
Tensile strength after accelerated extraction	CRD C 572	1600 psi minimum
Elongation after accelerated extraction	CRD C 572	300%
Effect of Alkalis after 7 days-Weight Change	CRD C 572	0.10% to +0.25%
Effect of Alkalis after 7 days-Hardness Change	CRD C 572	+5 maximum

F. Manufacturers:

1. 9 in. waterstops:

   a. No. 708 as manufactured by Greenstreak Plastic Products Company, St. Louis, MO.
   b. RCB-938 as manufactured by Bo Metals, Inc. Carrolton, GA.
   c. Catalog No. RB938 as manufactured by Vinylex Waterstop & Accessories St. Louis, MO.
   d. Or approved equal.

2. 6 in. waterstops:

   a. No. 703 as manufactured by Greenstreak Plastic Prducts Company, St. Louis, MO.
   b. RCB-938 as manufactured by Bo Metals, Inc. Carrolton, GA.
   c. Catalog No. RB6316 as manufactured by Vinylex Waterstop & Accessories St. Louis, MO.
   d. Or approved equal.

PART 3 - EXECUTION

3.1 FABRICATION

A. Make all splices on a bench following manufacture's printed instructions and splicing procedures.

B. Use miter guide and portable power saw to cut spliced ends.

C. Maintain continuity of characteristic features of waterstop cross section, including ribs and center bulb, through splice.

D. Remove looped steel wire along both edges of waterstop adjacent to saw cut prior to splicing.

E. Make splices by heat-sealing adjacent surfaces using a thermostatically controlled electric heat source in conformance with manufacturer's printed instructions.

F. Reform waterstop at splices using a remolding iron having a pattern matching the waterstop.

G. After splice has cooled, spark test all splices in conformance with manufacture's printed instructions. If splice shows any separation or lack of fusion, reject the splice, re-cut back at least one inch from rejected splice each side, re-weld and retest.

H. Replace or repair damaged or punctured waterstops in conformance with manufacture's printed instructions at no additional cost to the Owner.

I. Clean waterstops of curing compound, foreign materials and protrusions of hardened concrete and mortar.

3.2 INSTALLATION

A. Place waterstop to form a continuous watertight diaphragm in joints.

B. Center waterstops in joints unless otherwise indicated.

C. Install waterstops in continuous lengths to minimize field splices.

D. Maintain 2-in. minimum clearance between waterstop and reinforcement and embedded items.

E. Do not bend waterstops in forms. Use factory-made and spark tested crosses, tees and ells at all corners and intersections.

F. Do not fold waterstops against bulkhead forms.

G. Secure waterstops in position with tie wire from loops to adjacent reinforcement on both sides every 12 in. along each edge.

H. Consolidate concrete during placement in vicinity of waterstop without damaging or dislodging waterstop.

I. Protect exposed waterstop from damage.

J. Do not install split waterstops unless specifically indicated.

END OF SECTION

SECTION 031520

HYDROPHILIC RUBBER WATERSTOPS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. Provide as an alternative to polyvinyl chloride waterstops, hydrophilic rubber waterstops as indicated and specified.

1.3 REFERENCES

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

1. D638: Test Method for Tensile Properties of Plastics
2. D1149: Test Method for Rubber Deterioration – Surface Ozone Cracking in a Chamber
3. D1203: Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods
4. D2240: Test Method for Rubber Property – Durometer Hardness

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with the requirements as specified in Section 013300, SUBMITTAL PROCEDURES.

1. Manufacture’s printed data and literature for all specified materials and locations where materials are to be used.

B. Samples of waterstops.

C. Certification that materials proposed for use are non-toxic and have no effect the quality or appearance of potable water. Materials shall be NSF approved for contact with potable water.

1.5 QUALITY CONTROL

A. Provide in accordance with the requirements as specified in Section 014500, QUALITY CONTROL.

B. Reject and replace waterstops that have become wet or exhibit swelling prior to concrete placement.

C. Require a manufacture’s service representative to visit the job site before any waterstops are installed to demonstrate the correct installation and splicing procedures.

D. Correctly position waterstops in joints.

E. Provide waterstops in maximum practical lengths to minimize joints.

F. Use adhesives manufactured by or recommended by the waterstop manufacturer for attachment of the waterstop to concrete.

G. Waterstops shall be positioned to provide a minimum of 3” concrete cover.

1.6 DELIVERY, STORAGE AND HANDLING

A. Transport, handle and deliver materials to the job site in the manufacturer’s sealed bags, unopened containers or banded pallets.

B. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.

C. Store hydrophilic waterstops under cover in a dry cool location, out of direct sunlight. Waterstops shall be maintained in a dry condition until concrete placement.

PART 2 - PRODUCTS

2.1 HYDROPHILIC GASKET WATERSTOPS

A. Provide hydrophilic rubber gasket waterstops fabricated of non-vulcanized rubber, chloroprene rubber, urethane polymers, vinylester polymers or combinations of these materials.

B. Waterstops shall be of solid construction and 3/8” X 3/4” minimum in cross section.

C. Provide waterstops as recommended by the manufacturer for specific installation.

D. Waterstops containing bentonite shall not be used.

E. Provide hydrophilic gasket waterstops that meet or exceed the criteria in Table 03256-1.

TABLE 03256-1

Property	Test Method	Limit
Ultimate Elongation	ASTM D 412	550% minimum
Tensile Strength	ASTM D 412	350 psi minimum
Specific Gravity	ASTM D 792	1.18 to 1.38
Hardness, Shore A	ASTM D 2240	40 to 60

F. Provide hydrophilic rubber gasket waterstops as manufactured by:

1. Hydrotite as manufactured by Greenstreak Plastic Products Company, St. Louis, MO.
2. Swellseal 2010 manufactured by De Neef Construction Chemicals, Inc., Waller, TX.
3. Or approved equal.

2.2 HYDROPHILIC PASTE WATERSTOPS

A. Provide hydrophilic rubber paste waterstops of urethane paste, thixotropic vinyl monomer or similar materials.

B. Hydrophilic rubber paste shall be compatible with waterstop material.

C. Hydrophilic paste shall be 100% solids.

D. Provide hydrophilic paste waterstops that meet or exceed the criteria in Table 03256-2.

TABLE 03256-2

Property	Test Method	Limit
Ultimate Elongation	ASTM D 412	100% minimum
Tensile Strength	ASTM D 412	25 psi [170 kPa] minimum
Ozone Resistance	ASTM D 1149	No Failure
Volatile Loss	ASTM D 1203	0.50% maximum
Hardness, Shore A	ASTM D 2240	30 to 60

E. Provide hydrophilic rubber paste as manufactured by:

1. Leak Master manufactured by Greenstreak, St. Louis, MO.
2. Swellseal Cartridge manufactured by De Neef Construction Chemicals, Inc.,Waller, TX;
3. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide hydrophilic rubber gasket and paste waterstops where specifically indicated. Provide ribbed center bulb polyvinyl chloride waterstops in expansion joints unless otherwise indicated.

B. Center waterstops in joints unless otherwise indicated. Provide the minimum clear coverage specified by the manufacturer.

C. Consolidate concrete during placement in vicinity of waterstop without damaging or dislodging waterstop.

D. Clean joint surface of dirt, dust, debris and laitance immediately before applying waterstop and remove standing water.

E. Protect waterstops from moisture until concrete is placed. Waterstops that exhibit swelling prior to concrete placement shall be removed and replaced at the Contractor's expense.

3.2 HYDROPHILIC GASKET WATERSTOPS

A. Install hydrophilic gasket waterstops in continuous lengths to minimize joints. Provide waterstop in one continuous length as practicable. Butt ends at joints of waterstop or overlap a minimum per manufacturer's instructions.

B. Seal joints in hydrophilic gasket waterstops with a hydrophilic rubber paste compound as recommended by the manufacturer.

C. Do not bend hydrophilic gasket waterstop. Cut square and butt joints at corners.

D. Waterstop shall be in continuous contact with the concrete surface.

E. Attach hydrophilic gasket waterstop to concrete surface by one of the following methods:

1. Fix hydrophilic gasket waterstop to concrete surface with continuous bead of hydrophilic rubber paste or adhesive. Paste or adhesive shall be provided by or as recommended by the waterstop manufacturer.

F. Fix hydrophilic gasket waterstop to concrete surface with masonry or concrete nails or powder activated fasteners at a maximum 12-inch spacing.

G. Provide one fastener one inch from the top and a second fastener four inches from the top of vertical hydrophilic gasket waterstops regardless of which fastening method is used.

H. Do not compress or otherwise deform hydrophilic gasket waterstop when fastening to concrete.

I. Do not wrap hydrophilic gasket waterstops around pipes less than the minimum diameter recommended in the manufacture's printed instructions.

3.3 HYDROPHILIC PASTE WATERSTOPS

A. Clean dirt and debris from area to receive hydrophilic paste waterstop.

B. Bead of hydrophilic paste waterstop shall be a minimum of 1/4 by 1/2 inches.

C. Apply hydrophilic paste waterstop such that there is no break in the bead.

D. Place hydrophilic paste waterstop bead continuously around pipe near the center of the wall were used for sealing pipe penetrations. Allow hydrophilic paste waterstop to cure for 24 hours before placing concrete to avoid the possibility of tearing the caulk from the pipe during concrete placement.

E. Install hydrophilic paste waterstops in accordance with the manufacture's printed instructions.

END OF SECTION

SECTION 032000

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. This Section specifies all work necessary to provide all concrete reinforcement such as reinforcing steel, welded wire fabric, and concrete inserts as shown on the Drawings and as specified herein.

1.3 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 315: Details and Detailing of Concrete Reinforcement
2. ACI 315R: Manual of Engineering and Placing Drawings for Reinforced Concrete Structures

B. American Society for Testing and Materials (ASTM):

1. A1064 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
2. A 615: Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
3. A 706/A 706M: Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement

C. American Welding Society (AWS):

1. AWS D1.4: American Welding Society, Structural Welding Code, and Reinforcing Steel.

D. Massachusetts State Building Code

1.4 SUBMITTALS

A. Submittal for the following items shall be made in accordance with the requirements as specified.

B. Shop Drawings:

1. Shop drawings for reinforced concrete structures shall be submitted after the concrete pour sequences, construction joint locations, and placement schedules have been approved by the Engineer.
2. At least 30 days before each scheduled concrete placement, submit shop drawings covering the reinforcing steel details, bar lists, support bars and details, locations of

reinforcing bar cut-offs, splices, development lengths and placement details. Prepare shop drawings in accordance with ACI 315 and 315R from reinforcement details shown on the drawings.

3. Mill Certificates: Accompanying the shop drawings, submit steel producer's certification of mill analysis, tensile, and bend tests for reinforcing steel.
4. Welder's certification in conformance with AWS D1.4 when welding is indicated or specified. Testing of welds shall be conducted and witnessed by an independent testing laboratory prior to welding of reinforcement. Maintain qualification and certification records at the job site, readily available for examination of test results.

C. Manufacture's literature, including installation instructions for the following.

1. Supports

1.5 QUALITY ASSURANCE

A. Provide in accordance with the requirements of the Quality Control section and as specified.

B. Do not fabricate reinforcement until shop and placement drawings have been approved by the Engineer.

C. Tolerances:

1. Tolerances shall be as specified in ACI 315R.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver reinforcement to the job site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on shop drawings.

B. Storage: Store reinforcement at the job site in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing bars shall be newly rolled deformed bars conforming to ASTM A615 Grade 60, unless otherwise indicated on the Drawings.

1. Bars to be welded shall conform to ASTM A706 deformed, Grade 60.
2. Provide mill bent reinforcing bars, bent cold to the dimensions indicated and conforming to the requirements of ACI SP-66.

B. Welded wire fabric shall conform to ASTM A 1064, with a minimum ultimate tensile strength of 70,000 psi. Provide in sizes indicated. Provide support bars and reinforcing bar supports as specified to obtain concrete cover.

C. Bar support and accessories shall be galvanized or plastic coated and shall conform to ACI 315. Provide minimum size number 5 support bars.

D. Provide 3-in. by 3-in. plain precast concrete blocks and precast concrete doweled blocks for reinforcing bar supports in foundation mats, base slabs, footings, pile caps, grade beams and slabs on grade. Provide block thickness to produce concrete cover of reinforcement as indicated. Provide blocks of Type II cement with 3000 psi minimum compressive strength in conformance with the Section 033000, Cast-in-Place Concrete.

E. Wire for tying reinforcement in place shall be No. 16 AWG or heavier black soft-annealed wire

2.2 FABRICATION

A. Fabricate reinforcement only after shop drawings have been returned by the Engineer marked “Approved”.

B. Provide reinforcing bars that have been cut and bent before shipment. If bars must be bent on site, bend reinforcing steel cold, and do not straighten or rebend in a manner which will damage the material. Bend in conformance with requirements of ACI SP-66 or with ASTM A767 when reinforcement is to be galvanized.

C. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying for the full length of the splice. All lap splices shall be ACI 318, Class B, unless indicated otherwise on the Drawings.
2. Adjacent splices shall be staggered whenever possible.

PART 3 - EXECUTION

3.1 GENERAL

A. General: Comply with Concrete Reinforcing Steel Institute’s recommended Practice for “Placing Reinforcing Bars”, for details and methods of reinforcement placement and supports, and as herein specified.

3.2 PLACEMENT

A. Comply with the specified standards for details and methods of reinforcement placement and supports, and as herein specified. Comply with concrete protective cover requirement indicated on the Drawings.

B. Clean reinforcement to remove loose rust and mill scale, earth, and other materials that would reduce or destroy bond with concrete.

C. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain the specified coverage for concrete protection. Arrange, space, and securely tie bars and bar supports together with wire, to hold reinforcement accurately in position during concrete placement operation. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh.

F. Provide support of sufficient numbers and strengths to carry reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for conveying equipment and similar construction loads.

G. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits or embedded items. Bars moved more than three inches are subject to the approval of Engineer. Place required number of bars.

H. Position dowels accurately, rigidly support, and securely tie. Align dowels normally to concrete surface before concrete placement. Setting dowels into wet concrete is prohibited.

I. Provide and place safety caps on all exposed ends of vertical reinforcement.

J. Tie a minimum of 25 percent of all intersecting bars in foundation mats, base slabs, footings, pile caps, slabs on grade and elevated slabs.

K. Do not splice reinforcement steel in foundation mats, base slabs, beams, girders, slabs and walls at points of maximum stress unless otherwise indicated.

L. Lap splice welded wire fabric reinforcement at least one full mesh. Stagger splices to avoid continuous laps in either direction and wire tightly together. Straighten rolled welded wire fabric reinforcement into flat sheets before use.

M. Provide continuous reinforcement through construction joints.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. This Section specifies requirements for furnishing, placement, finishing, curing and protecting of all concrete, plain and reinforced as shown on the Drawings and as specified herein. Review and approval of the Contractor's Working drawings by the Engineer does not relieve the Contractor of the responsibility for the adequacy of Work.

1.3 REFERENCES

A. General: Where the language in any of the documents referred to herein be in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory for these Specifications.

B. American Concrete Institute (ACI):

1. ACI 117: Standard Tolerances for Concrete Construction and Materials (except as modified in this Specification Section for anchor rod placement).
2. ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete
3. ACI 213: Guide for Structural Lightweight Aggregate Concrete
4. ACI 301: Specifications for Structural Concrete
5. ACI 302: Guide for Concrete Floor and Slab Construction
6. ACI 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete.
7. ACI 305R: Hot Weather Concreting
8. ACI 306: Cold Weather Concreting
9. ACI 308: Standard Practice for Curing Concrete
10. ACI 309R: Guide for Consolidation of Concrete
11. ACI 310: Specifications for Structural Concrete
12. ACI 318: Building Code Requirements for Structural Concrete

C. American Society for Testing and Materials (ASTM):

1. C31 Making and Curing Concrete Compression and Flexural Strength Test-Specimens in the Field
2. C33 Specification for Concrete Aggregates
3. C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. C94 Specifications for Ready Mixed Concrete
5. C127 Standard test method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
6. C136 Sieve Analysis of Fine and Coarse Aggregate
7. C138 Unit Weight, Yield, and Air Content of Concrete

8. C143 Test for Slump of Portland Cement Concrete
9. C150 Specification for Portland Cement
10. C171 Sheet Materials for Curing Concrete
11. C172 Sampling Fresh Concrete
12. C173 Standard test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
13. C595 Standard Specifications for Portland Blast Furnace Slag Cement
14. C231 Test for Air Content of Freshly Mixed Concrete by the Pressure Method
15. C260 Specification for Air-Entraining Admixtures for Concrete
16. C309 Specification for Liquid Membrane Forming Compounds for Curing Concrete
17. C330 Specification for Lightweight Aggregates for Structural Concrete
18. C340 Standard Specifications for Portland-Pozzolan Cement
19. C494 Specification for Chemical Admixtures for Concrete
20. C618 Standard Specifications for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
21. C827 “Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
22. C845 Standard Specifications for Expansive Hydraulic Cement
23. C989 Specification for Ground Iron Blast-Furnace Slag for Use in Concrete and Mortars
24. C1017 Standard Specifications for Chemical Admixtures for Use in Producing flowing Concrete
25. C1064 Test Method for Temperature of Freshly Mixed Portland-Cement Concrete
26. C1107: Specification for Packaged Dry, hydraulic Cement Grout (Non-Shrink)
27. C1157 Standard Performance Specifications for Silica Fume in Cementitious Mixtures
28. C1240 Standard Specification for Silica Fume for Use in Hydraulic-Cement Concrete
29. D1751: Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
30. E154 Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

D. Federal Specifications (Fed. Spec.):

1. TT-S-00230: Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)

1.4 DESIGN REQUIREMENTS

A. Codes: Building concrete shall be in conformance with the requirements of ACI 310, and the Massachusetts State Building Code.

B. Coordinate use of curing compounds with the floor coatings, sealers, and hardeners.

C. Air-entrain all exterior exposed concrete and lightweight concrete.

1.5 SUBMITTALS

A. Product Data: Submit design mix including color additives as applicable. Submit manufacturer’s product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, synthetic fibers, admixtures, color additives, patching compounds, waterstops, joint systems, curing compound, and others as requested by the Engineer.

B. Shop Drawings: Submittals included in the Section shall be in accordance with the requirements specified. Submit Working drawings for all Work under this Section to the Engineer for approval. Show location of joints, concrete pouring sequence, schedule dates, rate of placement and methods. All concrete mix designs shall conform to ACI-310 and as specified. All concrete mix designs and concrete material tests shall be signed and sealed by a Professional Engineer in the State of Massachusetts.

C. Samples: Submit samples of materials as specified, including names, sources and descriptions.

D. Laboratory Test Reports: Submit laboratory test reports for concrete, concrete materials, and mix design tests.

E. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

F. Submit prior to start of Work written reports of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been approved by the Engineer.

G. Batch Ticket Information: Provide concrete delivery tickets showing job name and location, date and time of delivery, quantity of concrete, quality and type of concrete, admixtures, amount of water added, and all other relevant information as described in ASTM C-94. Submit original batch tickets and 2 copies at the end of each week.

1.6 QUALITY ASSURANCE

A. Provide in accordance with the requirements as specified.

B. Concrete Testing Service: The Contractor shall employ and pay an independent testing laboratory to perform material evaluation tests and to design concrete mixes and provide copies of recently made material tests and mix designs.

C. Materials and installed Work may require testing and retesting at any time during progress of Work. Allow free access to material stockpiles and facilities. All tests, including retesting of rejected materials and installed Work, shall be done at Contractor’s expense.

D. Workmanship: The Contractor is responsible for correction of corrected Work that does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed at no additional cost to the Owner.

1.7 DELIVERY, STORAGE AND HANDLING

A. Order concrete from batching plant so that trucks arrive at discharge locations when concrete is required. Avoid excessive mixing of concrete or delays in placing successive layers of concrete in forms.

B. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the water-cement ratio, slump, air entrainment, temperature and homogeneity.

C. Concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket will be rejected.

1.8 JOB SITE

A. Weather: Protect concrete from damage and reduce strength or performance due to weather extremes during mixing, placing and curing.

B. Cold Weather: Unless special precautions are taken to protect concrete, do not Work when temperatures are below 40°F or when temperatures are expected to fall below 40°F within 72 hours after placing concrete.

1. Comply with ACI 306 in cold weather.
2. Maintain concrete temperature of at least 60°F. Reinforcement, forms and ground in contact with concrete shall be free of frost.
3. Keep concrete and formwork at least 50°F for at least 96 hours after placing concrete.
4. The use of calcium chloride in any form is not permitted. Non-chloride accelerator shall be used when ambient temperature is below 50°F.
5. Admixture manufacturers shall provide technical assistance at no additional cost. A manufacturer's representative shall be available for consultation by phone or on site upon 72-hour notice.

C. Hot Weather: Concrete, when deposited, shall be less than 85°F. Cool the mix in a manner acceptable to the Engineer if the concrete temperature is higher.

1. Comply with ACI 305 in hot weather.
2. Retarder shall be used when ambient temperature exceeds 80°F.

D. Schedule delivery of colored concrete to provide consistent mix times from batching until discharge.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II for all Work unless otherwise specified. Use one brand of cement throughout the project.

B. Fly Ash and Ground Granulated Blast-Furnace Slag: Fly Ash shall conform with ASTM C 618, Type F or C. Ground Granulated Blast-Furnace Slag shall conform with ASTM C 989, Grade 100 or 120. Products used shall be of the same type, brand, and source throughout the Project. 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. Normal Weight Aggregates: ASTM C 33, and as herein specified. Use ¾" maximum size for all concrete, unless noted otherwise. Provide aggregates from a single source for exposed concrete.

D. Lightweight Aggregates: ASTM C 330, ¾" nominal maximum aggregate size.

E. Water: Clean, potable and free from foreign materials such as oils, acids, alkalis, and organic materials in amounts harmful to concrete and embedded steel. Provide water which meets ACI/ASTM requirements for concrete mix water.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include the following

a. “Air-Mix”; Euclid Chemical Co.
b. “Sika AeA-14”; Sika Corp.
c. “MasterAir VR 10 or MasterAir AE 90”; Master Builders
d. “Darex AEA” or “Daravair”; W.R. Grace
e. Or equal.

G. Water Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1% chloride ions. Follow manufacturer’s recommendations for amount of admixture to be added to the concrete. Admixture shall be compatible with air-entraining admixtures.

1. “WRDA with Hycol”; W. R. Grace.
2. “Eucon WR-75”; Euclid Chemical Co.
3. “Master Pozzolith” Master Builders
4. “Sikament 686”; Sika Chemical Corp.
5. Or equal.

H. High-Range Water Reducing Admixture (SuperPlasticizer): ASTM C 494, Type F or Type G and containing not more than 0.1% chloride ions. Follow manufacturer’s recommendations.

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include the following:

a. “ADVA CAST 585”; W. R. Grace.
b. “Super P”; Anti-Hydro.
c. “Sikament 686”; Sika Chemical Corp.
d. “Master Rheobuild 1000”; Master Builders.
e. Or equal.

I. Water Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E or C, and containing not more than 0.1% chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ”Accelguard 80”; Euclid Chemical Co.
b. “MasterSet FP 20”; Master Builders, Inc.
c. “PolarSet”; Grace Construction Products.
d. Or equal.

J. Water Reducing, Retarding Admixture: ASTM C 494 Type D, and containing not more than 0.1% chloride ions.

1. Products: Subject to compliance with requirements, products that may be incorporated in the Work include the following:

a. "MasterPozzolith-80"; Master Builders.
b. "Eucon Retarder 75"; Euclid Chemical Co.
c. "Daratard 17"; W. R. Grace.
d. "Plastiment"; Sika Chemical Co.
e. Or equal.

K. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1% chloride ions are not permitted.

2.2 RELATED MATERIALS

A. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. Per sq. yd., complying with AASHTO M 182, Class 2.

C. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

D. Joint Sealants shall be provided in color to match color of concrete.

E. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

a. "MasterKure"; Master Builders.
b. "A-H 3 Way Sealer WB"; Anti-Hydro Waterproofing Co.
c. "Kurez DR VOX"; Euclid Chemical Co.
d. "Clear Seal": A.C. Horn, Inc.
e. "Sealco 309"; Gifford-Hill/American Admixtures.
f. "Cure & Seal LV 25% J20UV"; Dayton Superior.

F. Underlayment Compound: Free flowing, self-leveling, pumpable cementitious base compound.

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

a. "Ardex K-15"; Ardex Engineered Cements.
b. "Silflo 230"; Silpro Masonry Systems.
c. "Ultraplan"; Mapei.

G. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

a. Acrylic or Styrene Butadiene:

1) "J-40 Bonding Agent"; Dayton Superior Corp.
2) "Everbond"; L & M Construction Chemicals.
3) "Hornweld"; A. C. Horn, Inc.
4) "Daraweld C"; W. R. Grace.

H. Adjustable inserts: Adjustable inserts shall be hot-dip galvanized in conformance with ASTM A123 and A153. Adjustable insets shall be:

1. Ductile iron wedges inserts, Type F-7 manufactured by Dayton Sure-Grip & Shore Co.
2. Malleable iron peerless wedge inserts, insert as manufactured by Richmond Screw, Anchor Co., Inc.
3. Malleable iron wedge inserts, Type HW as manufactured by Hohmann & Barnard Inc.

I. Vapor barrier shall be Stego Wrap Vapor Barrier (15 mil) or equivalent, in accordance with ASTM E 1745. Use caution to avoid perforations in the vapor barrier material. Install barrier in accordance with ASTM E 1643 and ASTM F 710 guidelines.

J. Concrete Moisture Vapor Reduction Admixture (MVRA): MVRA shall be provided at all interior slabs-on-grade and slabs-on-metal deck.

1. MVRA Basis-of-Design Product: "Barrier One MVRA-CPS" by Barrier One Concrete Admixtures. Other admixtures must be compatible with the MVRA. Subject to compliance with requirements, comparable products which may be incorporated in the Work include, but are not limited to, the following:

a. MVRA 900 by ISE Logik, Inc.
b. Architect/Engineer approved equivalent.

2.3 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If the trial batch method used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Submit written reports for review of design mix for specified strength of concrete within 15 days prior to start of Work. Do not begin concrete production until mixes have been reviewed.

C. Normal weight concrete mixes: Provide normal weight concrete having the following minimum compressive strength at 28 days. For lightweight concrete mixes, refer to Paragraph 2.3.D.

1. Class 4000 – 3/4" normal weight concrete: Typical, unless noted otherwise.
2. Class 4000 – 3/8" normal weight concrete: Concrete fill at metal pan stairs (only).
3. Class 5000 – 3/4" normal weight concrete: 5" concrete on 3" metal deck (8" total thickness), exterior site pads, and retaining walls

The concrete quality, mixing and placing shall conform to ACI-310.

Design mixes to provide normal weight concrete with the following properties, as indicated:

Minimum Design Compressive Strength	Minimum Strength fc 7 days	Laboratory Testing Age 28 day	Minimum ** Cement Content/cu.yd.	Maximum* W/C Ratio
4,000 (3/4") psi	2,400 psi	4,000 psi	565	0.45
4,000 (3/8") psi	2,400 psi	4,000 psi	611	0.45
5,000 (3/4") psi	3,500 psi	5,000 psi	705	0.40

*Maximum: Decrease if possible
**Minimum: Increase as necessary to meet all other stated requirements.

D. Lightweight concrete mixes (slabs on composite metal deck where indicated on the Drawings): Proportion structural lightweight concrete mixture as follows:

1. Minimum Compressive Strength: 3,500 psi at 28 days (2,100 psi at 7 days).
2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C 567.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by the Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the Engineer before using in Work.

F. Admixtures:

1. Use water-reducing admixture or high range water reducing admixture (super plasticizer) in all concrete in strict accordance with the manufacturer's printed instructions.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50°F in strict accordance with the manufacturer's printed instructions.
3. Use high-range water-reducing admixture in pumped concrete required to be watertight, and concrete with water/cement ratios below 0.40.
4. Use air-entraining admixture in all concrete, unless otherwise indicated. Do not air-entrain interior slabs-on-grade or slabs-on-metal deck that utilize normal weight concrete. Lightweight concrete slabs shall be air-entrained. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content as follows:

   a. ¾" aggregate normal weight concrete: 6.0% with a tolerance of ±1%
   b. ¾" aggregate lightweight concrete: 4% to 7%.

G. Consistency:

1. The consistency shall be uniformly maintained within the allowable range of slump for the job materials. Ordinarily the slump shall not be less than 1-1/2" inch nor more than 4 inches, unless in the opinion of the Engineer, job conditions warrant exceeding these limits. The consistency shall be determined by the AASHTO Method T-119. This range of slump is to be maintained for all concrete including pumped concrete.
2. Concrete containing HRWR admixture (super-plasticizer): Not more than 7" after addition of HRWR to site-verified 1-1/2" to 4" slump concrete.
3. Ramps, slabs and sloping surfaces: Not more than 3 inches, except lightweight slabs not more than 5 inches.

4. Reinforced foundation systems: Not less than 1-1/2” inch nor more than 4 inches.

H. Concrete Moisture Vapor Reduction Admixture (MVRA) shall be used in strict accordance with the manufacturer’s printed instructions. The MVRA manufacturer shall provide a minimum 10-year warranty effective from the date of substantial completion. In order to qualify for the warranty, the following items must be implemented prior to placement of the concrete:

1. Concrete mix design is submitted to MVRA manufacturer for review and comment.
2. Concrete supplier must verify in writing that strict water/cement ratio compliance has been met for all concrete batches utilizing the waterproofing admixture.
3. Concrete supplier must verify in writing that manufacturer’s instructions for use at batch plant were strictly followed for batches provided for the job.

2.4 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When air temperature is between 85°F (30° C) and 90°F (32° C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.
2. During cold weather heat water, sand and cement materials per recommendations of ACI 306.

B. High Early Strength Concrete: Follow manufacture’s product specific installation guidelines. Cement shall be added to a pre-measured amount of water that does not exceed the manufacturer’s maximum recommended water content. Material can be extended up to 60% using pea gravel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Batch, mix and deliver Portland cement concrete in conformance with ASTM C 94. Batch all constituents at central batching or mixing plant. Produce concrete in conformance with ACI 301 and as specified.

B. Seasonal Conditions:

1. Conform to ACI 305R and as specified for hot weather concreting. Do not add retarder admixture to any concrete.
2. Conform to ACI 306R and as specified for cold weather concreting. Do not add accelerator admixture to any concrete.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into Work, anchorage devices and other embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto. Embedded items, including column anchor rods and concrete reinforcement, shall be set prior to the

placement of concrete. Embedded items shall not be “wet-set” without prior written approval from the Engineer of Record.

B. Install anchor rods, accurately located, to elevation required and complying with the following tolerances (acceptable deviation from rod locations shown on the Drawings):

1. 3/4” and 7/8” diameter rods: +/- 1/4”
2. 1”, 1-1/4”, and 1-1/2” diameter rods: +/- 3/8”
3. 1-3/4”, 2”, and 2-1/2” diameter rods: +/- 1/2”

C. Clean embedded items of oil, ice, dirt and all other foreign items.

D. For embedded pipes, complete all necessary testing requirements prior to placing concrete.

3.3 PLACING CONCRETE

A. General:

1. Concrete formwork shall satisfy the requirements of Section 03 11 00, Concrete Formwork. Do not place concrete until the depth, character and adequacy of forms, falsework, embedments, and the placing of the steel reinforcement have been approved by the Engineer. The method and manner of placing the concrete shall be such as to avoid segregation of aggregate and displacement of the reinforcement. Troughs, pipes and chutes may be used as aids in placing concrete when necessary. Dropping the concrete a distance of more than five feet, or depositing a large quantity at one point, will not be permitted. Concrete shall be placed upon clean, damp surfaces, free from running water, or upon properly consolidated soil.
2. Do not add water to concrete during delivery, at the Project site, or during placement, unless approved by the Engineer of Record. The amount of water to be added at the project site shall be indicated on the mix design and batch tickets submitted by the contractor. Water shall be added prior to on-site testing of the concrete mix.
3. Before placing concrete, and if agreed upon by the Engineer of Record, water may be added at the Project site, subject to the limitations of ACI 301.

    a. Do not add water to concrete after adding high-range water-reducing admixtures.

4. Retempering of concrete by adding water or any other material shall not be permitted.
5. Concrete placement, finishing and curing, and all other pertinent construction practices shall be in accordance with ACI 117 and ACI 301. In addition to the requirements of ACI 117 and ACI 301, the following shall apply:

    a. Concrete shall be placed so that a uniform appearance of surfaces will be obtained.
    b. Concrete shall be placed and consolidated free of rock pockets, honeycombs, and voids.
    c. Concrete shall be deposited as nearly as practicable in its final position, to avoid segregation due to rehandling or flowing, and shall not be subjected to any procedure that will cause segregation.
    d. Concrete shall be placed and consolidated in walls in approximately 18-inch layers, proceeding at a uniform rate or per the form designer’s recommendation.
    e. Subgrade shall be slightly moist when the concrete is placed for floor slabs, to prevent excessive loss of water from the concrete mix.

B. Consolidating:

1. Consolidate concrete with suitable mechanical vibrators operating within concrete. When necessary, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate consolidation. Vibrators shall be manipulated so as to Work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any joint shall be of sufficient duration to accomplish consolidation but shall not be prolonged to the point where segregation occurs.
2. Employ as many vibrators and tampers as necessary to secure the desired results. For every two vibrators required for the job, an additional standby vibrator shall be kept on the site. Do not place subsequent layers of concrete until the previous layer has been consolidated as specified. Internal vibrators shall have a minimum frequency of 8000 vibrations per minute when immersed in concrete and shall have sufficient amplitude to effectively consolidate the concrete.
3. Prevent the following practices:

    a. Pushing of concrete with vibrator.
    b. External vibration of forms.
    c. Allowing vibrator to vibrate against reinforcing steel where steel projects into green concrete.
    d. Allowing vibrator to vibrate against the contact faces of forms.

C. Cold Weather: Do not place concrete when the ambient temperature is below 40°F, unless specifically authorized by the Engineer. Conform to the requirements of ACI 306R during cold weather.

D. Hot Weather: Do not place concrete with a mix temperature exceeding 90°F, unless specifically authorized by the Engineer. Conform to the requirements of ACI 305R during hot weather.

E. Construction Joints:

1. When the placing of concrete is suspended, necessary provisions shall be made for joining future Work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, such provisions shall be made for grooves, steps, keys, dovetails, reinforcing bars or other devices as may be prescribed. Before depositing new concrete against concrete which has hardened, the surface of the hardened concrete shall be cleaned by a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout. Install joint sealant where shown on the Drawings, in accordance with manufacturer's instructions.
2. Joints shall be perpendicular to the main reinforcement.
3. Construction joints in floors shall be located within the middle third spans of slabs, beams, and girders.

F. Expansion and Control Joints: Expansion and control joints shall be constructed in the locations and to the dimensions and details shown on the Drawings.

G. Defective Work:

1. All defective Work disclosed after the forms have been removed shall be immediately removed and replaced. If dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows honeycomb, which in the opinion of the Engineer cannot be repaired satisfactorily, the entire Section shall be removed and replaced at no cost to the Owner.

2. Other Work considered to be defective includes, but is not limited to, the following:

    a. Concrete in which defective or inadequate steel reinforcement has been placed.
    b. Concrete incorrectly formed, or not conforming to details and dimensions on the Drawings or with the intent of these documents, or the concrete surfaces of which are out of plumb or level beyond specified tolerances.
    c. Concrete below specified strength.
    d. Concrete containing wood, cloth, or other foreign matter, rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the Drawings.

3.4 CONCRETE FINISHING

A. Exposed concrete surfaces shall be true, smooth, and free from open or rough spaces, depressions, or projections. The concrete in horizontal plane surfaces shall be brought flush with the finished top surface at the proper elevation and shall be struck off with a straightedge and floated. Mortar finishing will not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

B. Following placement of concrete for slabs and floors, tamp to force coarse aggregate away from surface, bull float, and steel trowel. Floor areas designated to receive a floor coating shall receive a finish as recommended by the coating manufacturer. Steel trowel finish shall be provided for surfaces that will receive flooring and all exposed floor areas.

C. Overall conformance to design grade shall be within ¾” of design elevation.

D. The following requirements shall govern concrete finishes so indicated on the Drawings.

1. Float Finish: Force coarse aggregate away from surface; float to a smooth and even surface.
2. Trowel Finish:

    a. After floating, begin the first trowel finish operation using a power-driven trowel; begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
    b. Do not over-trowel or start troweling late.
    c. Consolidate the concrete surface by the final hand troweling operation, free from trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8” in 10’-0” when tested with a 10’-0” straight–edge.

3. Apply nonslip broom finish to exterior concrete as specified, immediately after trowel finishing; roughen the concrete surface by brooming in the direction perpendicular to the main traffic route.

    a. Use a fiber bristle broom.
    b. Frequently clean broom to avoid deep brooming.

4. Finishing Formed Surface:

    a. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or Concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding ¼ inch in height rubbed down or chipped off.

b. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampprooofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projects, completely removed and smoothed.

c. Smooth-Rubbed Finish: Provide smooth-rubbed finish on scheduled concrete surfaces that have received smooth-formed finish treatment not later than one (1) day after form removal.

1) 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. Grout-Cleaned Finish: Provide grout-cleaned finish on scheduled concrete surfaces that have received smooth-formed finish treatment.

1) Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
2) Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least thirty-six (36) hours after rubbing.

e. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar uniformed 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 uniformed surfaces unless otherwise indicated.

E. Monolithic Slab Finishes: Apply finishes as indicated below. Finish surface FF and FL tolerances indicated below shall be considered minimum requirements. Where more stringent tolerances are provided in the specifications or construction documents for floor coverings and coatings or required by the manufacturer/installer of the floor covering or coating, the more stringent tolerance shall govern.

1. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

a. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

2. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using gloat blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

3. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or thinset quarry tile, paint, or another thin film-finish coating system.

a. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-toweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 30 (floor flatness) and F(L) 25 (Floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

4. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately flow by slightly scarifying the surface with a fine broom.
5. Non-slip Broom Finish: Apply a non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

a. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

6. Non-slip Aggregate Finish: Apply non-slip aggregate finish to concrete stair treads, platforms, ramps, sloped walks.

a. After completing float finishing and before starting trowel finish, uniformly spread 25 lbs. Of dampened non-slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.
b. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose non-slip aggregate.

3.5 CURING AND PROTECTION

A. Initial Curing: All concrete shall be properly cured and protected in accordance with ACI 308. Maintain concrete above 50 degrees F during first seven days after placing. The Work shall be protected from the elements, flowing water, and from defacement of any nature, during construction. The concrete shall be cured as soon as it has sufficiently hardened, by covering with an approved material. Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for a period of at least seven days. Curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to air currents. Where wooden forms are used, they shall be kept wet at all times until removed, to prevent the opening of joints and drying out of the concrete. Membrane curing compounds shall be coordinated with the surface to be painted, covered with

plaster, covered with sealer, and other surfaces which curing compound would adversely affect subsequent construction.

B. Duration of Curing: The final curing shall continue until the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the air in contact with the concrete is above 50°F, has totaled 7 days beyond the initial curing period.

1. If high-early strength concrete has been used, the final curing shall continue for a total of 3 days beyond the initial curing period.
2. Rapid drying at the end of the curing period shall be prevented.

C. Formed Surfaces: Steel forms heated by the sun and all wood forms in contact with the concrete during the curing period shall be kept wet.

1. If forms are to be removed during the curing period, one of the specified curing materials or methods shall be employed immediately.
2. Such curing shall be continued for the remainder of the curing period.

3.6 CONCRETE SURFACE REPAIRS

A. General: Any defective Work disclosed after removal of forms shall be immediately removed and replaced. If in the opinion of the Engineer, the surface of the concrete cannot be repaired satisfactorily, the entire Section shall be removed and replaced at no additional expense to the Owner.

B. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to the Engineer.

1. Cut out honeycomb, rock pockets, voids over 1” in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1”. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

C. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

D. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the Engineer. Surface defects, as such, include color and texture irregularities, bulges, uneven surfaces, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

E. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

F. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic labs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

G. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least ¾" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

H. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cutout holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

I. Perform structural repairs with prior approval of the Engineer for method and procedure, using specified epoxy adhesive and mortar.

J. Repair methods not specified above may be used, subject to acceptance of the Engineer.

3.7 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. A statement of special inspections will be established by the Registered design professional in responsible charge who will prepare a schedule of tests to be carried out by an independent testing agency. All costs for inspection and testing shall be borne by the Owner. Materials and workmanship shall be subjected to inspection and testing in mill, shop, and/or filed by the Registered design professional in responsible charge and/or Testing Agency. Such inspection and testing shall not relieve the Contractor of his responsibility to provide his own inspection, testing, and quality control as necessary to furnish materials and workmanship in accordance with requirements of Contract Documents.

B. The General Contractor shall notify the Registered design professional in responsible charge and the Testing Agency prior to start of any phase of concrete work so as to afford them reasonable opportunity to inspect the work. Such notification shall be made at least 24 hours in advance.

C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

1. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; one for each day's pour of each type of air-entrained concrete.
3. Concrete Temperature: Test hourly when air temperature is 40°F and when 80°F and above; and each time a set of compression test specimens are required.
4. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

a. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches if fewer than 5 are used.
b. When total quantity of a given class of concrete is less than 50 cu. yds, strength test may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided.
c. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
d. Strength level of concrete will be considered satisfactory if both of the following requirements are met:

    1) Every arithmetic average of any three consecutive strength tests equals or exceeds the specified 28-day compressive strength (f'c).
    2) No individual strength test results falls below the specified 28-day compressive strength (f'c) by more than 500 psi when f'c is 5000 psi or less; or by more than 0.1 x f'c when f'c is greater than 5000 psi.

D. Test results will be reported in writing to the Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name and location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials: compressive breaking strength and type of break for both 7-day tests and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

F. Additional Tests: The Contractor's Independent testing service shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed.

G. Concrete Moisture Vapor Reduction Admixture (MVRA) Requirements: A representative or agent of the MVRA manufacturer must be present at the jobsite during placement of all MVRA treated concrete. Do not proceed without this representative being present. The General Contractor is to notify the manufacturer and make available to the site and batching plant for tests, inspection, and recommendations pertaining to the product.

END OF SECTION

SECTION 036000

GROUTING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. This Section specifies the furnishing and installing non-shrink grout for pump, motor, and equipment base plates or bedplates; column base plates and miscellaneous base plates; and other uses of non-shrink grout as indicated on the Drawings. Unless otherwise specified, all grouting shall be done with non-shrinking grout.

B. This section also specifies furnishing and installing two-component epoxy-based adhesive anchoring systems for anchor bolts, threaded rod anchors, and reinforcing bars to be installed in hardened concrete and masonry.

1.3 SUBMITTALS

A. Submit Certificate of Compliance of products with these specifications.

B. Submit the following in accordance with the requirements as specified in Section 013300, SUBMITTAL PROCEDURES.

1. Manufacturer’s printed data and literature for all specified materials and locations where materials are to be used.
2. Manufacturer’s installation/application instructions.

1.4 QUALITY ASSURANCE

A. Provide in accordance with the requirements as specified in Section 014500, QUALITY CONTROL.

B. Ensure surfaces to be grouted are clean and sound and are not feathered at edges.

C. Handle grout as concrete with regard to temperature and curing as specified in Section 03 30 00, Cast-in-Place Concrete.

D. Observe safety precautions as outlined in the manufacturer’s literature and as printed on containers and labels.

PART 2 - PRODUCTS

2.1 NON-SHRINK CEMENT

A. Provide non-shrink, non-metallic cement-based grout requiring only addition of water with a minimum 28-day compressive strength of 8,000 psi.

1. Provide shrinkage and compensation characteristics in both the plastic and hardened states, conforming to ASTM C-1107, Grade C.
2. Grout shall exhibit a small but predictable amount of expansion sufficient to counteract the normal shrinkage of cement.
3. The expansion shall occur after the initial set to insure maximum contact between grout and base plates, beams, concrete, masonry, or other surfaces.
4. Manufactured by:

a. “Five Star Grout” by Five Star Products Inc.
b. “Sika Grout 212” as manufactured by Sika Corporation.
c. “Masterflow 928” by Master Builders, Inc.
d. Or approved equal.

2.2 EPOXY ADHESIVE FOR REINFORCING BARS AND THREADED ROD ANCHORS

A. Epoxy adhesive shall be a multi-purpose 2 component, 100% solids, moisture tolerant structural epoxy-based adhesive.

1. Manufactured by:

a. “HIT-HY 200” (concrete) and “HIT-HY 270” (masonry) by Hilti, Inc.
b. “SET-3G” by Simpson Strong-Tie Company, Inc.
c. Or approved equal.

PART 3 - EXECUTION

3.1 NON-SHRINKING GROUT

A. Non-shrinking grout shall be furnished factory premixed so that only water is added at the jobsite. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

B. Preparation

1. The concrete or masonry surfaces to receive non-shrinking grout shall be saturated with water for at least 12 hours preceding grouting unless additional time is required by the grout manufacturer. Remove all standing water or puddles prior to application of grout.
2. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles and disintegrated materials by mechanical abrasion methods such as sandblasting. Sandblast structural and reinforcing steel to remove loose material and expose sound metal.
3. Construct appropriate sturdy forms to contain grout at the fluidity level at which it will be used.

C. Placement

1. Unless otherwise specified or indicated on the drawings, grout under base plates shall be ¾-inches thick.
2. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the top of base plates and bedplates are completely filled, without voids.
3. Forms shall be provided where structural components of base plates or bedplates will not confine the grout.
4. Place grout only from one side of base plates to avoid entrapping air. Provide adequate air vent holes in large base plates. Work or flow into place, filling all cavities.
5. Reinforce grout pads or applications three inches or more in thickness with wire mesh or reinforcement bars.
6. Excessive means of vibration may cause segregation of aggregates and will not be permitted.

D. Edge Finishing

1. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smoothly after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the base plates, bedplates, members, or pieces of equipment.

E. Curing

1. Nonshrinking grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After the edge finishing is completed, the grout shall be wet cured for at least 3 days and then an acceptable membrane-curing compound shall be applied.

3.2 EPOXY ADHESIVE

A. Epoxy adhesive shall consist of a two-component liquid epoxy adhesive of viscosity appropriate to the location and application, and an inert aggregate filler component, if recommended by the adhesive manufacturer. Components shall be packaged separately at the factory and shall be mixed immediately before use. Proportioning and mixing of the components shall be done in accordance with the manufacturer's printed instructions and recommendations.

B. Preparation

1. Where indicated on the drawings, anchor bolts, threaded rod anchors, and reinforcing bars shall be anchored in holes drilled into hardened concrete and masonry using epoxy adhesive. Diameters of holes shall be in accordance with the Manufacturer's Printed Installation Instructions (MPII) included with each adhesive package.
2. The embedment depth for anchor bolts, threaded rod anchors, and reinforcing bars shall be as indicated on the Drawings.
3. Holes shall be prepared and cleaned in accordance with the Manufacturer's Printed Installation Instructions (MPII) included with each adhesive package.

C. Installation

1. Anchor bolts, threaded rod anchors, and reinforcing bars shall be clean, dry, and free of grease and other foreign matter when installed.
2. The bolts, rods, and bars shall be set and positioned and the adhesive shall be placed and finished in accordance with the recommendations of the manufacturer.

3. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids.
4. During assembly of all threaded stainless-steel components, anti-seize thread lubricant shall be liberally applied to the threaded portion not embedded in concrete.

END OF SECTION

SECTION 040001

MASONRY WORK

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 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. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 040001 – MASONRY WORK

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-001 TYPICAL EXTERIOR ASSEMBLIES
AD-010 SITE DEMOLITION PLAN
AD-100 BASEMENT DEMOLITION PLAN
AD-101 FIRST FLOOR DEMOLITION PLAN
AD-102 SECOND FLOOR DEMOLITION PLAN
AD-103 ROOF DEMOLITION PLAN
AD-104 DEMOLITION 3D VIEWS
A-010 SITE PLAN
A-100 BASEMENT PLAN

A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-110 ROOF PLAN
A-300 EXTERIOR ELEVATIONS
A-301 EXTERIOR ELEVATIONS
A-302 PROPOSED 3D VIEWS
A-400 BUILDING SECTIONS
A-401 BUILDING SECTIONS
A-402 BUILDING SECTIONS
A-403 BUILDING SECTIONS
A-500 WALL SECTIONS
A-501 WALL SECTIONS
A-502 WALL SECTIONS
A-503 WALL SECTIONS
A-520 SECTION DETAILS
A-521 SECTION DETAILS
A-522 SECTION DETAILS
A-523 SECTION DETAILS
A-530 PLAN DETAILS
A-531 PLAN DETAILS
A-532 PLAN DETAILS
A-600 ELEVATOR DRAWINGS
A-603 EXTERIOR STAIR AND RAMP DRAWINGS
A-800 DOOR SCHEDULE AND DETAILS
A-801 DOOR DETAILS
A-802 DOOR DETAILS
A-810 WINDOW SCHEDULE AND DETAILS
A-811 WINDOW DETAILS

E. DESCRIPTION OF WORK

F. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. All Work of Section 040120 – MASONRY RESTORATION AND CLEANING
2. All Work of Section 042000 – UNIT MASONRY
3. All Work of Section 047200 – CAST STONE MASONRY

END OF SECTION

SECTION 040120

MASONRY RESTORATION AND CLEANING

(Part of Work of Section 040001 - MASONRY WORK, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Repairing clay and masonry, including replacing damaged units as indicated on Drawings.
2. Repointing mortar joints, removing existing mortar and replacing with new color mortar.
3. Provide for repair or replacement of clay and stone masonry broken or damaged during disassembly and reconstruction. Contractor shall be responsible for damage resulting from work of this Section.
4. Provide shoring and bracing required to maintain stability of masonry during work of this Section. Coordinate with requirements of Section 011000 - GENERAL REQUIREMENTS.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 024100 - DEMOLITION for demolition, removal and salvage requirements, to the extent not specified in this Section.
2. Section 042000 - UNIT MASONRY for new clay masonry veneer.
3. Section 047200 - CAST STONE MASONRY for new stone masonry veneer.
4. Section 076200 - SHEET METAL FLASHING AND TRIM for metal flashing installed in or on restored masonry.
5. Section 079200 - JOINT SEALANTS for sealing joints in restored masonry.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

B. Samples for Verification: Before erecting mockup, submit samples of the following:

1. Each type of exposed masonry unit to be used for replacing existing units.

a. For each brick type, provide straps or panels containing at least four bricks.

2. Each type of sand used for pointing mortar.

a. For blended sands, provide samples of each component and blend.
b. Identify sources, both supplier and quarry, of each type of sand.

3. Each type of pointing mortar in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.

a. Include with each sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

4. Each type of masonry patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each sample with manufacturer and stock number or other information necessary to order additional material.

C. Restoration Program: For each phase of restoration process, provide detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of restoration work including protection of surrounding materials on building and Project site.

1. Include methods for keeping pointing mortar damp during curing period.
2. If materials and methods other than those indicated are proposed for any phase of restoration work, provide a written description, including evidence of successful use on comparable projects, and a testing program to demonstrate their effectiveness for this Project.

D. Cleaning Program: Describe cleaning process in detail, including materials, methods, and equipment to be used and protection of surrounding materials on building and Project site, and control of runoff during operations.

1. If materials and methods other than those indicated are proposed for cleaning work, provide a written description, including evidence of successful use on comparable projects, and a testing program to demonstrate their effectiveness for this Project.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of material for masonry restoration (face brick, stone, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.

B. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to test the following. Provide test specimens and assemblies as indicated.

1. Replacement Brick: For each proposed type of replacement brick, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).
2. Existing Brick: For each type of existing brick indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove existing bricks from locations designated by Architect.

C. Mockups: Prepare mockups of restoration and cleaning as follows to demonstrate aesthetic effects and qualities of materials and execution. Prepare mockups on existing walls under same weather conditions to be expected during remainder of the Work.

1. Repair an area approximately 36 inches high by 48 inches wide for each type of masonry material indicated to be rebuilt or replaced.
2. Patch three small areas at least 1 inch in diameter for each type of masonry material indicated to be patched.
3. Clean an area approximately 25 sq. ft. in area for each type of masonry and surface condition.

    a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions unless cleaners and methods are known to have deleterious effect.
    b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

4. Rake out joints in two separate areas approximately 36 inches high by 72 inches wide for each type of repointing required and repoint one of the two areas.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.

B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store lime putty covered with water in sealed containers.

F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.6 PROJECT CONDITIONS

A. Repoint mortar joints and repair masonry only when air temperature is between and 40 and 90 deg F and is predicted to remain so for at least 7 days after completion of work.

B. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing:

1. When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 7 days after repair and pointing.

C. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair

materials. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 90 deg F and above.

D. Patch masonry only when air and surface temperatures are between and 55 and 100 deg F and are predicted to remain above 55 deg F for at least 7 days after completion of work. On days when air temperature is predicted to go above 90 deg F, schedule patching work to coincide with time that surface being patched will be in shade or during cooler morning hours.

E. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least 7 days after completion of cleaning.

1.7 SEQUENCING AND SCHEDULING

A. Order replacement materials at earliest possible date, to avoid delaying completion of the Work.

B. Order sand for repointing mortar immediately after approval of Samples or mockups. Take delivery of and store at Project site a sufficient quantity of sand to complete Project.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units to comply with Part 3 "Masonry Unit Patching and Repairs" Article. Patch holes in mortar joints to comply with Part 3 "Repointing Masonry" Article.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Face Brick and Accessories: Provide face brick and accessories, including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.

1. Provide units with colors, surface texture, size, and shape to match existing brickwork and with physical properties not less than those determined from preconstruction testing of selected existing units.

    a. For replacement brick at existing building provide brick to match existing as approved by Architect.
    b. For existing brickwork that exhibits a range of colors, provide brick that matches that range rather than brick that matches an individual color within that range.

2. Provide units with colors, surface texture, and physical properties to match Architect's sample. Match existing units in size and shape.

    a. For sample that exhibits a range of colors, provide brick that matches that range rather than brick that matches an individual color within that range.

3. Provide specially molded shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
4. Provide specially ground units, shaped to match patterns, for arches and where indicated.

B. Building Brick: Provide building brick complying with ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.

1. Grade SW where in contact with earth.

2. Grade SW, MW, or NW for concealed backup.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II.

1. Provide white cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Sand: ASTM C 144, unless otherwise indicated.

1. Color: Provide natural sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
2. For pointing mortar, provide sand with rounded edges.
3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands, if necessary, to achieve suitable match.

D. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. SGS Mortar Colors: Solomon Grind-Chem Services, Inc.
b. True Tone Mortar Colors: Davis Colors, a Subsidiary of Rockwood Industries, Inc.

E. Water: Potable, clean and free from injurious amount of oil, alkali, organic matter or other deleterious material.

2.3 MISCELLANEOUS MATERIALS

A. Masonry Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching masonry, is vapor- and water permeable, exhibits low shrinkage, and develops high bond strength to all types of masonry.

1. Formulate patching compound used for patching brick in colors and textures to match brick being patched. Provide number of colors needed to enable matching each brick.
2. Available Products:

a. Cathedral Stone Products, Inc.; Jahn Restoration Mortar.
b. Edison Coatings, Inc.; Custom System 45.
c. Bonstone Materials Corp., Stone Repair.

B. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

1. Available Products:

a. American Building Restoration Products, Inc.; LM 130 Acid Shield.
b. Diedrich Technologies Inc.; Diedrich Acid Guard.

c. Price Research, Ltd.; Price Mask.
d. ProSoCo; Sure Klean Strippable Masking.

C. Joint Sealant and Backer Rods: Refer to Section 079200 - JOINT SEALANTS.

2.4 MORTAR MIXES

A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

C. Colored Mortar: Produce mortar of color required by using selected ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.
2. Color: Match existing, or as otherwise directed by Architect.

D. Do not use admixtures of any kind in mortar, unless otherwise indicated.

E. Mortar Proportions: Mix mortar materials in the following proportions:

1. Pointing Mortar for Brick: 1 part portland cement, 2 parts lime, and 6 parts sand.

a. Add mortar pigments to produce mortar colors required.

2. Rebuilding (Setting) and Pointing Mortar, for Stone: Comply with ASTM C 270, Proportion Specification, Type N, unless otherwise indicated, with cementitious material limited to portland cement and lime.

a. Mix: 1 part portland cement, 2 parts lime, and 6-7 parts sand.
b. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.

1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.

B. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and projections to protect from mortar droppings.
2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
3. Immediately remove mortar in contact with exposed masonry and other surfaces.
4. Clean mortar splatters from scaffolding at end of each day.

3.2 MASONRY UNIT PATCHING AND REPAIRS

A. Patch the following masonry units:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners.
4. Units with small areas of deep deterioration.

B. Remove and replace existing patches, unless otherwise indicated or approved by Architect.

C. Patching Bricks:

1. Remove loose material from brick surface. Remove additional material so patch will not have feathered edges and will be at least 1/4 inch thick, but not less than recommended by patching compound manufacturer.
2. Mask or remove surrounding mortar joints if patch will extend to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surface plane of surrounding brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.3 REPOINTING MASONRY

A. Rake out and repoint mortar joints to the following extent:

1. All joints in areas indicated.
2. Joints where mortar is missing or where they contain holes.
3. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
4. Cracked joints where cracks are 1/8 inch or more in width and of any depth.
5. Joints where they sound hollow when tapped by metal object.
6. Joints where they are worn back 1/4 inch or more from surface.
7. Joints where they are deteriorated to point that mortar can be easily removed by hand.
8. Joints, other than those indicated as sealant-filled joints, where they have been filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows:

1. Remove mortar from joints to depth of 2 times joint width, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

    a. Cut out mortar by hand with chisel and mallet. Do not use power-operated grinders without Architect's written approval based on submission by Contractor of a satisfactory quality-control program and demonstrated ability of operators to use tools without damaging masonry. Quality-control program shall include provisions for supervising performance and preventing damage due to worker fatigue.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and mallet. Strictly adhere to written quality-control program. Quality-control program shall include provisions for demonstrating ability of operators to use tools without damaging masonry, supervising performance, and preventing damage due to worker fatigue.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Point joints as follows:

1. Rinse masonry-joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen masonry-joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer.

    a. Where existing bricks have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces.
    b. Take care not to spread mortar over edges onto exposed masonry surfaces or to featheredge mortar.

4. When mortar is thumbprint hard, tool joints to match original appearance of joints. Remove excess mortar from edge of joint by brushing.

F. Cure mortar by maintaining in thoroughly damp condition for at least 72 hours including weekends and holidays.

1. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
2. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Wash adjacent woodwork and other nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean masonry debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Sweep and rake adjacent pavement and grounds to remove masonry debris. Where necessary, pressure wash surfaces to remove mortar, dust, dirt, and stains.

3.5 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare test reports. Coordinate with inspectors and provide access. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

END OF SECTION

SECTION 042000

UNIT MASONRY

(Part of Work of Section 040001 - MASONRY WORK, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Concrete masonry units.
2. Face brick.
3. Embedded flashing.
4. Mortar and grout.
5. Reinforcing steel, masonry joint reinforcement, ties and anchors.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 047200 - CAST STONE MASONRY for cast stone units.
2. Section 061600 - SHEATHING for gypsum sheathing on cold-formed metal framing.
3. Section 072100 - THERMAL INSULATION for cavity wall insulation.
4. Section 072700 - AIR BARRIERS for membrane air barrier.
5. Section 078440 - FIRE-RESISTIVE JOINT SYSTEMS for fire-resistive joint systems openings in masonry walls and at heads of masonry walls.
6. Section 079200 - JOINT SEALANTS for sealing control and expansion joints in unit masonry.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, “Details and Detailing of Concrete Reinforcement.”

C. Samples for Verification: For each type and color of the following:

1. Exposed concrete masonry units.
2. Face brick, in the form of straps of five or more bricks.

3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
4. Weep holes/vents.
5. Accessories embedded in masonry.

D. Qualification Data: For testing agency.

E. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units:

   a. Include material test reports substantiating compliance with requirements.
   b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
   d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780 for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019 for grout mixes required to comply with compressive strength requirement.

G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: The Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be

made by the Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

1. Prism Test: For each type of construction required, per ASTM C 1314.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

F. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 for mockups.

1. Build sample panels for typical exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness.
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

G. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Agenda shall include protection of air barrier membrane during construction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Air Barrier Membrane: During construction, protect air barrier membrane from penetrations which allow air to pass through air barrier assemblies. Engage original installer to repair damage promptly using identical materials and methods of installation, and to the satisfaction of the Architect.

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

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

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

D. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

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

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

F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMUS)

A. Concrete Masonry Units: ASTM C 90, normal weight unless indicated otherwise manufactured to dimensions 3/8 inch less than nominal dimensions.

B. Shapes: Provide standard shapes indicated and as required for building configuration. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

2.2 BRICK

A. Regional Materials: Provide brick that has been manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Face Brick: ASTM C 216, Grade SW, Type FBS.

1. Trade Reference and Color: As selected by Architect.
2. Size (Actual Dimensions): As selected by Architect.
3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated “not effloresced.”
5. Where shown to “match existing,” provide face brick matching color range, texture, and size of existing adjacent brickwork.

C. Building (Common) Brick where Concealed: ASTM C 62, Grade SW.

D. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
5. Units which are sawn and less than one-half full size shall not be used.

2.3 MORTAR AND GROUT MATERIALS

A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Available Products:

a. LanXess; Bayferrox Iron Oxide Pigments.
b. Davis Colors; True Tone Mortar Colors.
c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

E. Aggregate for Mortar: ASTM C 144. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

F. Aggregate for Grout: ASTM C 404.

G. Water: Potable.

2.4 REINFORCEMENT

A. Environmental Product Declarations (EPD): Industry-wide EPDs for steel reinforcements (rebars) are available from the Concrete Reinforcing Steel Institute (CRSI).

B. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

C. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Mill-galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size and Spacing: As required by Code.
4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod at each wythe of masonry 4 inches or less in width.

2.5 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
6. Stainless Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

B. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.

C. Partition Top Anchors: 0.097-inch-thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, with structural performance capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
2. Screw-Attached, Masonry-Veneer Anchors: Units equal to HB-213 Adjustable Veneer Anchor or HB-5213 Adjustable Veneer Anchor by Hohmann & Barnard, Inc., consisting of a wire tie and a metal anchor section.

    a. Anchor Section: Rib-stiffened, sheet metal plate with 9/32 inch diameter screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes with 1-1/4 inch maximum allowable eccentricity, sized to prevent in-and-out movement beyond allowable tolerances, for inserting vertical legs of wire tie specially formed to fit anchor section.
    b. Wire Ties: Rectangular-shaped wire ties fabricated from 0.188-inch-diameter, hot-dip galvanized steel wire.

2.6 MISCELLANEOUS ANCHORS

A. Anchor Bolts: L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Section 076200 - SHEET METAL FLASHING AND TRIM and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick.
2. Configuration: Provide continuous flashing including preformed outside, inside corners, and end dams with smooth uninterrupted soldered seams and hemmed edges to maintain continuity. See drawings for profiles required.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 – SHEET METAL FLASHING AND TRIM.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer’s standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates. Verify compatibility between flashing materials and substrates.

D. Transition Strips: Provide long-term compatible 6” wide transition strips to seal embedded flashing terminations to air barrier membrane.

E. Drip Edge: Provide type 316, 0.016 inch (0.40 mm) thick stainless steel drip edge plates with factory applied adhesive strip for all through-wall flashing conditions. Provide preformed outside and inside corner drip plate corners with smooth uninterrupted soldered seams and hemmed drip edges to maintain continuity. Custom sizes will be required see drawings for profiles required.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Provide strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings or equivalent. Available products:

1. Advanced Building Products Inc.; Mortar Break II.
2. Archovations, Inc.; CavClear Masonry Mat.
3. Hohmann & Barnard; MortarTrap.
4. Mortar Net USA, Ltd.; Mortar Net.

2.9 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar to portland cement and lime.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Pigmented Mortar: Use colored cement product. Pigments shall not exceed 10 percent of portland cement by weight.

1. Color: To be selected by Architect from Manufacturer's full range.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed. Do not use units cut to less than one-half size.

E. Do not install concrete masonry units with more than 5 percent damage to the face. Do not install brick units which will show defects after installation.

F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

G. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

H. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs. Prior to installation review bond pattern with Architect.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

F. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

G. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078440 – FIRE-RESISTIVE JOINT SYSTEMS.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using bonding system indicated on Drawings.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coordinate and allow access for air and vapor barrier membrane installed in cavity under Section 072700 - AIR BARRIERS.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches. Space reinforcement not more than 16 inches o.c.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through insulation and sheathing to wall framing and to concrete and masonry backup as applicable with metal fasteners of type indicated.
2. Embed tie sections in masonry joints. Provide air space indicated on the Drawings between back of masonry veneer and face of insulation.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as required by Code.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick made from clay or shale as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 - JOINT SEALANTS.

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 - JOINT SEALANTS but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge covered with elastomeric membrane, lapping at least 4 inches.
4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
5. Install air barrier transition strips to seal embedded flashings in masonry to air barrier membrane in accordance with Section 072700 – AIR BARRIERS.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install metal drip edge plate in accordance with architectural details and manufacturer’s requirements.

E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches o.c., unless otherwise indicated.

F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 “Miscellaneous Masonry Accessories” Article.

G. Install vents in head joints in exterior wythes at spacing indicated.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace,

tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.13 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof. Test types as determined by the independent testing and inspection agency.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, around penetrations and where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

6. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 - EARTHWORK.
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Site.

END OF SECTION

SECTION 047200

CAST STONE MASONRY

(Part of Work of Section 040001 - MASONRY WORK, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Cast stone trim.
2. Calcium silicate masonry veneer units.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042000 - UNIT MASONRY for cast stone trim installation.
2. Section 054000 - COLD-FORMED METAL FRAMING for metal framing at exterior wall.
3. Section 061600 - SHEATHING for substrate.
4. Section 076200 - SHEET METAL FLASHING AND TRIM for metal flashing.

1.3 DEFINITIONS

A. Cast Stone: Architectural precast concrete building units intended to simulate natural cut stone.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for cast stone units.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Verification:

1. For each color and texture of cast stone required, 10 inches square in size.
2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicated types and amounts of pigments used.

D. Mockup Samples: Furnish sample units for each color and texture of cast stone required, as indicated on Drawings for installation in mockups.

E. Qualification Data: For manufacturer.

1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.

F. Quality-Control Plan: Manufacturer's written quality-control plan that includes all elements of the Cast Stone Institute's "Quality Control Procedures Required for Plant Inspection."

1. Provide copies of documentation showing compliance with quality-control plan as requested by Architect.

G. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.

1. Provide test reports based on testing within previous two years.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, with sufficient production capacity to manufacture required units.

1. Manufacturer is a producing member of the Cast Stone Institute or has on file and follows a written quality-control plan approved by Architect that includes all elements of the Cast Stone Institute's "Quality Control Procedures Required for Plant Inspection."

B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations for Cast Stone: Obtain cast stone units through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. Store installation materials on elevated platforms, under cover, and in a dry location.

D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

PART 2 - PRODUCTS

2.1 CAST STONE TRIM

A. Available Manufacturers:

1. Arriscraft, International.
2. Continental Cast Stone East.
3. MGA Cast Stone.
4. Sun Precast Co.

B. General: Comply with ASTM C 1364 and the following:

1. Color and Texture: To be selected by Architect from Manufacturer's full range.
2. Sizes: As indicated on Drawings.
3. Provide units with factory finish at exposed faces.

C. Portland Cement: ASTM C 150, Type I, containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

1. Color: White or Gray.

D. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures and colors as needed to produce required cast stone colors.

E. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation as needed to produce required textures and colors as needed to produce required cast stone colors.

F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis. The amount of pigment shall not exceed 10% by weight of the cement used.

G. Admixtures: Do not use admixtures unless specified or approved in writing by Architect.

H. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.

1. Epoxy Coating: ASTM A 775/A 775M.
2. Galvanized Coating: ASTM A 767/A 767M.

I. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.

J. Provide cast stone units complying with ASTM C 1364.

1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C 1364.

K. Fabricate units with sharp arris and details accurately reproduced with indicated texture on all exposed surfaces, unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12, unless otherwise indicated.

2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements, unless otherwise indicated.

L. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

M. Cure units by one of the following methods:

1. Cure units with steam in enclosed curing room at temperature of 105 deg F or above and 95 to 100 percent relative humidity for 6 hours.
2. Cure units with dense fog and water spray in enclosed warm curing room at 95 to 100 percent relative humidity for 24 hours.
3. Cure units to comply with one of the following:

a. Not less than 5 days at mean daily temperature of 70 deg F or above.
b. Not less than 6 days at mean daily temperature of 60 deg F or above.
c. Not less than 7 days at mean daily temperature of 50 deg F or above.
d. Not less than 8 days at mean daily temperature of 45 deg F or above.

N. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

2.2 CALCIUM SILICATED UNITS

A. Available Manufacturers:

1. Arriscraft, International.
2. Meno Natural Stone.
3. Earthworks Stone.

B. Calcium Silicate Masonry Units: ASTM C73, Grade SW; solid units that have been pressure formed and autoclaved; and then cut to thickness indicated; special shapes as indicated; and as follows:

1. Basis of Design: Arriscraft; Renaissance and Fresco Series.
2. Size: 23-5/8 inches long by 3-5/8 inches deep.
3. Length: As indicated on Drawings.
4. Compressive Strength: 6600 psi, to ASTM C170.
5. Absorption: 8.8 percent, to ASTM C97.
6. Density: 120 lbs/ft3, to ASTM C97.
7. Modulus of Rupture: 770 psi, to ASTM C99.
8. Color: To be selected by Architect from Manufacturer’s full range of full bed units.

C. Fabricate Calcium Silicate Units to the following tolerances:

1. Unit Length: plus or minus 1/16".
2. Unit Height: plus or minus 1/16".

3. Deviation From Square: plus or minus 1/16", with measurement taken using the longest edge as the base.
4. Bed Depth: plus or minus 1/8".
5. Custom Dimensions: plus or minus 1/8".
6. Unit Face Deviations: plus or minus 3/8”.

2.3 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.

B. Dowels: Round stainless-steel bars complying with ASTM A 276, Type 304, and 1/2-inch (12-mm) diameter.

2.4 MORTAR MATERIALS

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

1. Compressive Strength (ANSI A118.4 Modified): >4000 psi (27.6 MPa).
2. Water Absorption (ANSI A118.6): ≤ 5%.
3. Service Rating (TCA/ASTM C627): Extra Heavy.
4. Smoke & Flame Contribution (ASTM E84 Modified): 0.
5. Total VOC Content: < 0.05 mg/m3.

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

1. Compressive strength (ANSI A118.4): >2500 psi (17.2 MPa).
2. Bond strength (ANSI A118.4): >450 psi (3.1 MPa).
3. Smoke & Flame Contribution (ASTM E84 Modified): 0.
4. Total VOC Content: < 0.05 mg/m3.

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

1. Compressive Strength (ANSI A118.7): 4500 psi (31 MPa).
2. Tensile Strength (ANSI A118.7): >500 psi (3.45 MPa).
3. Flexural Strength (ANSI A118.7): >1250 psi (8.6 MPa).
4. Water Absorption (ANSI A118.7): < 5%.
5. Linear Shrinkage (ANSI A118.7): < 0.05 %.
6. Smoke & Flame Contribution (ASTM E84 Modified): 0.
7. Total VOC Content: < 0.05 mg/m3.

D. Water: Potable.

PART 3 - EXECUTION

3.1 CAST STONE TRIM INSTALLATION

A. Part of the Work of Section 042000 – UNIT MASONRY.

3.2 INSTALLATION OF CALCIUM SILICATE UNITS

A. Comply with manufacturer's recommendations.

B. Include started course where calcium silicate units meet grade as indicated on Drawings.

C. Cutting:

1. Cut thin Calcium Silicate Units with a wet-saw.
2. Pre-soak units using clean water prior to cutting.
3. Clean cut units using a stiff fiber brush and clean water. Allow units to surface dry prior to placement.
4. Thin calcium silicate units shall be cut accurately to shape and dimensions and full to the square, with jointing as shown on drawings
5. Any miscellaneous cutting and drilling of thin calcium silicate units necessary to accommodate other trades will be the responsibility of the installer.
6. Incidental cutting such as for window frame clips, etc., which is normally not considered to be the responsibility of the thin calcium silicate unit supplier, will be provided only by arrangement by the Contractor with the thin calcium silicate units supplier.

D. Install flashing over sheathing and behind weather-resistant sheathing paper by fastening through sheathing into framing.

E. Coat backs of units and face of scratch coat with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units and scratch coat.

F. Rake out joints for pointing with mortar to depth of not less than 3/4 inch before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.3 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch deep. Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:

1. Joint Profile: As indicated.

3.4 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.

END OF SECTION

SECTION 050001

MISCELLANEOUS AND ORNAMENTAL IRON

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 050001 –Miscellaneous and Ornamental Iron

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-110 ROOF PLAN
A-300 EXTERIOR ELEVATIONS
A-301 EXTERIOR ELEVATIONS
A-302 PROPOSED 3D VIEWS
A-400 BUILDING SECTIONS

A-401 BUILDING SECTIONS
A-402 BUILDING SECTIONS
A-403 BUILDING SECTIONS
A-500 WALL SECTIONS
A-501 WALL SECTIONS
A-502 WALL SECTIONS
A-503 WALL SECTIONS
A-520 SECTION DETAILS
A-521 SECTION DETAILS
A-522 SECTION DETAILS
A-523 SECTION DETAILS
A-530 PLAN DETAILS
A-531 PLAN DETAILS
A-532 PLAN DETAILS
A-600 ELEVATOR DRAWINGS
A-601 ENLARGED STAIR 2 DRAWINGS
A-602 ENLARGED STAIR 3 DRAWINGS
A-603 EXTERIOR STAIR AND RAMP DRAWINGS
A-800 DOOR SCHEDULE AND DETAILS
A-801 DOOR DETAILS
A-802 DOOR DETAILS
A-810 WINDOW SCHEDULE AND DETAILS
A-811 WINDOW DETAILS

S-001 STRUCTURAL NOTES
S-002 STRUCTURAL NOTES
S-020 TYPICAL DETAILS - 1
S-021 TYPICAL DETAILS - 2
S-022 TYPICAL DETAILS - 3
S-023 TYPICAL DETAILS - 4
S-024 TYPICAL DETAILS - 5
S-100 FOUNDATION PLAN
S-110 FIRST FLOOR FRAMING PLAN
S-120 SECOND FLOOR FRAMING PLAN
S-130 UPPER FLOOR FRAMING PLAN
S-140 LOW ROOF FRAMING PLAN
S-150 HIGH ROOF FRAMING PLAN
S-300 FRAMING SECTIONS AND DETAILS
S-301 FRAMING SECTIONS AND DETAILS
S-302 FRAMING SECTIONS AND DETAILS

1.2 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. All Work in Section 055000 - METAL FABRICATIONS.
2. All Work of Section 055100 - METAL STAIRS AND RAILINGS.

END OF SECTION

SECTION 051200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. Provide structural steel and related appurtenances as indicated and specified. The term “Structural Steel” is used as defined in accordance with the AISC Code of Standard Practice. For steel decking systems, refer to the steel decking specification.

1.3 REFERENCES

A. American Institute of Steel Construction AISC:

1. Specification for Structural Steel Buildings
2. AISC Manual of Steel Construction, Allowable Strength Design.
3. AISC Code of Standard Practice for Steel Buildings and Bridges
4. AISC Specification for Structural Joints using High Strength Bolts approved by the Research Council on Structural Connections.
5. AISC Structural Steel Detailing Manual

B. American Welding Society AWS.

1. AWS D1.1: Structural Welding Code - Steel

C. Steel Structures Painting Council (SSPC) Surface Preparation Specifications

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

1. A 6/A 6M: Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. A 36/A36M: Specification for Carbon Structural Steel.
3. A 194/A 194M: Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service
4. A 307: Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
5. F3125: Specification for High Strength Structural Bolts, Steel Heat Treated, 120/150 ksi Minimum Tensile Strength
6. A 449: Specification for Quenched and Tempered Steel Bolts and Studs
7. A 563: Specification for Carbon and Alloy Steel Nuts
8. F 436: Specification for Hardened Steel Washers

1.4 DESIGN REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer registered in the State of Massachusetts to prepare calculations, Shop Drawings, and other structural data for structural steel connections. Calculations shall be sealed by a professional engineer registered in the state of the project's location.

B. In accordance with the Code of Standard Practice, the Engineer in Responsible Charge of designing connections shall review and confirm in writing that the shop and erection drawings properly incorporate the connection designs, and the Fabricator shall provide a clear means by which the connection information is referenced to the related connections on the shop and erection drawings.

1.5 SUBMITTALS

A. Submit the following shop drawings:

1. Manufacturer's Literature: Provide manufacturer's literature describing standard items.
2. Shop drawings prepared under the supervision of a licensed Structural Engineer registered in Massachusetts, showing materials, sizes, finishes, locations, attached hardware and fittings, designs of connections not specifically shown on the drawings, and details for manufactured items and fabricated metalwork, including field erection details showing cuts, copes, connections, holes, thread fasteners and welds. Indicate welds, both shop and field, by symbols conforming to AWS standards. Indicate coatings or other protection against corrosion.
3. Setting diagrams, erection plans, templates, and directions for installation of backing plates, anchors, and other similar items.
4. Material compliance certification with standards designated.
5. Samples of materials proposed for use.
6. Test reports conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.
7. Certified copy of each survey conducted by a licensed Land Surveyor showing elevations and locations of base plates and anchor bolts to receive structural steel and final elevations and locations of major structural elements. Indicate discrepancies between actual installation and contract drawings.
8. Mill Certificates: Provide certificates signed by manufacturers certifying compliance of materials with standards designated.
9. Welding Certificates: Submit copies of certificates for welding personnel and procedure for each type of weld prior to welding.
10. The Contractor shall maintain records of test results of welding procedures and records of welders employed, date of qualification, and identification symbol or mark. Such records shall be available for examination by the Structural Engineer of Record and testing agency or submit certified copies.

1.6 QUALITY ASSURANCE

A. Tolerances:

1. Maintain tolerances conforming to AISC Code of Standard Practice.
2. Permissible variation tolerances conforming to ASTM A 6.

B. Tension Calibrator:

1. Employ an independent testing laboratory to calibrate and confirm the accuracy of the tension-measuring device when slip-critical connections and connections subject to direct tension are being used.

2. The calibrating device for setting calibrated torque wrenches shall be checked for accuracy by quality personnel not more than 30 days prior to its first use on the project, and at intervals not more than six months thereafter.
3. If the Engineer has reason to question the accuracy of the calibrating device, he may require that it be returned to the manufacturer for certification of its accuracy.
4. Provide tension calibrator measuring device at the job site when high-strength bolts in slip-critical connections and connections subject to direct tension are being installed and tightened.
5. Frequency and number of confirmation tests to be performed and the test procedure to be employed to conform to the AISC/RCSC Specification for Structural Joints using High Strength Bolts.
6. Return tension calibrator measuring device to the independent laboratory for certification if the Engineer questions its accuracy.
7. Use the tension calibrator-measuring device to tighten high-strength bolts in slip-critical connections and connections subject to direct tension in conformance with Table 051200-1 (Section 8 AISC/RCSC Specification for Structural Joints using High Strength Bolts).

Table 051200-1.

Fastener Tension Required for Slip-Critical Connections and Connections

Subject to Direct Tension

Nominal Bolt Size (inches)	Minimum Tension	
	Grade A325 Bolts (kips)	Grade A490 Bolts (kips)
½	12	15
5/8	19	24
¾	28	35
7/8	39	49
1	51	64
1 1/8	56	80
1 ¼	71	102
1 3/8	85	121
1 ½	103	148

C. Fabricator Qualifications:

1. Engage a firm experienced in fabricating structural steel similar to that indicated for this project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the work.
2. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:

   a. Category: Standard for Steel Building Structures (STD).
   b. Fabricator shall be registered with and approved by authorities having jurisdiction.

D. Welding Qualification and Certification

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

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

E. Test and Inspection

1. Inspection, Testing and Quality Control: A statement of special inspections will be established by the registered design professional in responsible charge who will prepare a schedule of tests to be carried out by an independent testing agency. All costs for inspection and testing shall be borne by the Owner.
2. The materials and workmanship to be finished under this Section shall be subject to inspection and testing in the mill, shop, and field by the Registered design professional in responsible charge and/or Testing Agency. Such inspection and testing shall not relieve the contractor of his responsibility to perform his own inspection and quality control and to furnish materials and workmanship in accordance with the requirements of the contract documents.
3. The Contractor and Testing Agency shall examine the contract documents and become thoroughly acquainted with detailed inspection and testing requirements as outlined by the Registered design professional in responsible charge.
4. The Contractor shall cooperate with and facilitate inspection and testing by the Registered design professional in responsible charge and/or Testing Agency. The Contractor shall, at his own expense, furnish the registered design professional in responsible charge and/or the Testing Agency upon request, with the following:

    a. A complete set of reviewed erection drawings, detailed shop drawings, schedules, and corrective work procedures at the fabricating shop or shops in the field.
    b. Cutting list, order lists, material bills, and shipping lists.
    c. Information as to time and place of all rollings and shipment of material to shops.
    d. Representative sample pieces requested for testing.
    e. Assistance for testing materials and proper facilities for inspection of the work, in the mill, shop, and field.

5. The Testing Agency shall inspect and test, as required by the registered design professional in responsible charge, all welded and bolted work.

    a. Shop-Bolted Connections: Inspect or test in accordance with AISC Specifications.
    b. Shop Welding: Inspect and test during fabrication of structural steel assembled, as follows:

        1) Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
        2) Perform visual inspections of all welds.
        3) Perform test welds as follows. Inspection procedures listed are to be used at Contractor's option.

            a) Liquid Penetrate Inspection: ASTM E 165
            b) Magnetic particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.
            c) Radiographic Inspection: ASTM E94; minimum qualify level "2-2T."
            d) Ultrasonic Inspection ASTM E 164.

6. Weldments and bolted connections that are required by the registered design professional in responsible charge and/or the Testing Agency to be corrected shall be corrected without delay at the Contractor's expense and to the satisfaction of the

registered design professional in responsible charge of the Testing Agency shall require drawings showing proposed corrective work to be submitted for review.

7. Any material or workmanship which is rejected by the registered design professional in responsible charge and/or the Testing Agency either in the mill, shop, or field shall be replaced promptly by the Contractor to the satisfaction of the registered design professional in responsible charge and/or the Testing Agency.
8. The fact that steel work has been accepted at the shop shall not prevent its final rejection at the job site, even after it has been erected, if found to be defective in any way.

1.7 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with the general equipment stipulations section and as specified herein.

B. The General Contractor, Sub-Contractors, and suppliers are all individually to furnish their own staging, scaffolding, and hoisting equipment necessary to get workers, materials, and equipment from the point of delivery at the project site to the point of use or installation within the building and project site. All crane and rigging services are the responsibility of each individual trade.

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

D. Deliver items to job site as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation. Items shall be delivered at such intervals to ensure uninterrupted progress of work.

E. Carefully handle and store materials, protected from weather, high heat, rusting corrosion and other damage.

F. Store material off the ground using pallets, platforms, or other useable supports with webs of flanged shapes vertical. Materials shall be stored to allow easy access for inspection and identification. Cover and protect steel from erosion and deterioration from snow, rain, and ground splatter.

G. Ship small parts, such as rivets, bolts, nuts, washers, pins, fillers, and small connecting plates and anchors, in boxes crates, or barrels. Pack separately each length and diameter of bolt and each size of nut and washer. Plainly mark and itemized list and description of the contents on the outside of each container. If bolts and nuts become dry and rusty, clean and relubricate before use.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural Steel Shapes:

1. High-Strength, Low-Alloy Steel: ASTM A 992 (ASTM A992M), Grade 50.

B. Miscellaneous Plates and Bars:

1. Carbon Steel: ASTM A 36 (ASTM A36M).

C. Cold-Formed Steel Tubing: ASTM A500, Grade B.

1. Items to be galvanized shall be hot-dip galvanized after fabrication in accordance with ASTM A123 or ASTM A153 as applicable.

2.2 FASTENERS

A. Carbon Steel Bolts, Nuts and Washers: ASTM A 307, Grade A.

B. High-Strength Carbon Steel Bolts, Nuts and Washers: ASTM F3125, Grade A325, Type 1.

C. Hot-Dipped Galvanized Bolts, Nuts, and Washers in conformance with ASTM A 153 and A 385.

1. High-strength carbon steel bolts, Type 1.
2. Grade DH, ASTM A 563 or Grade 2H, ASTM A 194 nuts.
3. Hardened washers in conformance with ASTM F 436.
4. Bees wax lubrication for threaded parts of bolts and nuts.
5. Purchase bolts, nuts and washers from a single supplier.

D. Do not use high-strength tension control bolts when bolts are galvanized.

2.3 WELDING

A. Class E70XX electrodes.

B. Provide equipment for welding, electrodes, welding wire and fluxes capable of producing indicated welds when used by certified welders under AWS welding procedures. Provide welding materials that comply with requirements of AWS Structural Welding Code.

2.4 PRIMERS

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another. GC shall submit certification demonstrating compatibility.

B. Primer: Comply with Division 9 painting Sections. Apply in accordance with manufacturer’s written instructions and recommendations.

2.5 GALVANIZING REPAIR PAINT

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 FABRICATION

A. Fabricate each element and connection as indicated on the fabrication shop drawings approved by the Engineer. Fabricate and shop assemble work to the greatest extent practical in conformance with the following publications:

1. AISC Manual
2. AISC Specification for Structural Joints
3. AISC Detailing Manual
4. AWS Structural Welding Code

B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

C. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings burrs, and other defects.

D. Insure that shearing, manual flame cutting with mechanically guided torch and chipping will not induce residual stress in metal being cut the Radii of re-entrant corners shall not be less than ¾ inch and perform flame cutting so that metal being cut is not carrying stress. Finish exposed edges.

E. Fabricate bearing stiffeners and stiffeners intended as supports for concentrated loads as indicated. Mill or grind bearing surfaces at stiffener ends.

F. Insure full cross section bearing on milled ends of columns, crane rails, monorails and bearing stiffeners.

G. Connections: Weld or bolt shop connections, as indicated. Bolt field connections, except where welded connections or other connections are indicated.

1. Provide high strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
2. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

H. Connect all members with ASTM F3125 Grade A325 high strength bolts unless otherwise indicated or specified. Install in accordance with AISC/RCSC “Specification for Structural Joints using High Strength Bolts”. Provide holes without torn or ragged edges and remove all outside burrs.

I. Welded Connections:

1. Connections indicated or specified shall be welded in accordance with AWS D1.1.
2. Provide complete weather seal weldments made with 1/16-inch minimum continuous fillets to all members having Type S and E service and to all welded connections that will be galvanized.

J. Weld or bolt shop connections in conformance with specified AWS Structural Welding Code and AISC publications.

K. Provide ASTM A 36 anchor bolts with washer and heavy hex nuts. Provide hot-dip galvanized anchor bolts, washers and heavy hex nuts with galvanized steel.

L. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

M. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

N. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes for bearing plates.

O. Corrective Work: Structural steel members or assemblages having fabrication errors, which exceed permissible tolerances, shall be corrected only if permitted by the SER. All corrective work shall be in accordance with AISC and AWS requirements. When requested by the SER or Testing Agency, the Contractor shall submit to the Architect and/or SER for approval, drawings showing details of proposed corrective work and shall receive approved drawing prior to performing the corrective work. All corrective work shall be solely at the Contractor's expense.

3.2 ERECTION

A. Survey: GC shall employ a licensed Land Surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceed. Report any discrepancies to the Architect and do no proceed with erection until corrections have been made or until adjustments to the structural steel work has been agreed upon the Architect.

B. Prior to setting column bases and bearing plates, clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates. Align column bases and bearing plates for beams and similar structural members with steel wedges or shims. Tighten anchor bolts after alignment and positioning members and fill entire area under bearing plates with non-shrink, non-metallic grout in accordance with grout section. Do not remove steel wedges or shims but if protruding, cut off flush with edge of base or bearing plate prior to grounding voids solids.

C. Provide anchor bolts and anchors with templates for correct placement into concrete, masonry or other supporting materials.

D. Hold steelwork securely in place with temporary bracing and stays to resist all vertical and lateral loads, until members are permanently fastened and floors and roofs completed. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Provide temporary planking or working platforms as necessary to effectively complete the work.

E. Use only calibrated wrenches for tensioning high-strength bolts for slip-critical joints and connections subjected to direct tension.

F. Inspect and torque test field-assembled bolted construction in conformance with AISC Specification for Structural Joints.

G. High-strength tension control bolting may be substituted for calibrated wrench bolting of slip-critical joints and connections subject to direct tension. Do not use high-strength tension control bolts when bolts are galvanized.

H. Set structural frames accurately to lines and elevations indicated. Align and adjust members forming parts of a complete assembly before permanent fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

I. Fasten splices (only where indicated and accepted on shop drawings) of compression members and members having milled ends after the abutting surfaces have been brought completely into contact.

J. Report errors in shop fabrication or deformation resulting from handling or transpiration immediately to Engineer. Replace and remove from job site incorrect fabricated or deformed material at no additional cost to the Owner.

K. Perform temporary bracing and bolting of work to support construction live load and combined dead, wind, earthquake and erection loads as erection progresses. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds. Leave bracing in place as long as necessary to provide safety.

L. Insure that holes are not enlarged and that metal in vicinity of holes is not damaged by drift pins during assembly.

M. Enlarge holes to admit bolts for connections only if approved in writing by the Engineer. Make enlargements only by drilling, avoid burning or hand reaming. Refinish enlarged holes with paint to match the shop coat. Use specific galvanize touch-up for galvanized members.

N. Flame cut bolt holes are not permitted.

O. Where erection bolts are abandoned in place, remove bolts, completely plug weld holes, grind smooth with adjacent surfaces and paint to match shop coat.

3.3 HIGH STRENGTH BOLTING

A. Provide workmanship and techniques for bolted construction in conformance with requirements of AISC/RCSC “Specifications for Structural Joints using High Strength Bolts” and as indicated or specified.

B. Install ASTM F3125 Grade A325 bolts with hardened washer under element being turned in tightening. Install plate washers in both outer plies when using oversize and slotted holes. Install galvanized washer under bolt head and nut when using galvanized bolts.

C. Do not reuse high-strength bolts, nuts and washers.

3.4 WELDING

A. Provide workmanship and techniques for welded construction to conform to requirements of AWS Structural Welding Code and as indicated or specified.

B. No field welding permitted unless indicated on Engineer approved fabrication shop drawings.

C. No field welding permitted on galvanized steel.

3.5 REPAIRS AND PROTECTION

A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

B. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections. Use specific galvanize touch-up for galvanized members.

END OF SECTION

SECTION 053100

STEEL DECKING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. This Section specifies furnishing and installing composite steel deck as indicated on the drawings.

1.3 REFERENCES

A. American Iron and Steel Institute (AISI):

1. Specifications for the Design of Cold-Formed Steel Structural Members published by American Iron and Steel Institute

B. Steel Deck Institute SDI: Publication No. 29:

1. Design Manual for Composite Decks, Forms Decks, Roof Decks and Cellular Deck Floor Systems with Electrical Distribution

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

1. ASTM A 1003: Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic-Coated Cold-Formed Framing Members.

D. ASTM A 653/A 653M:

1. Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process

E. ASTM A 780:

1. Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

F. American Welding Society AWS:

1. AWS D1.3: Structural Welding Code – Sheet Steel

G. Factory Mutual Engineering Corporation

1. FM 1-28: Loss Prevention Data

1.4 DESIGN REQUIREMENTS

A. Design Criteria:

1. Section properties of steel decking shall be calculated in conformance with AISI Specification for the Design of Cold-Formed Steel Structural Members.

B. Material and steel deck profiles shall conform to the applicable requirements of the Steel Deck Institute specifications.

C. Steel decking shall be capable of supporting a construction load of 200 pounds distributed over a one-foot width at midspans and at the ends of cantilevers with a maximum fiber stress of 26,000 psi and a maximum deflection of L/240.

1.5 SUBMITTALS

A. Submittals shall be provided in accordance with the requirements as specified in Section 013300, SUBMITTAL PROCEDURES.

B. Manufacturer: The designations of deck used on the drawings and specified herein are those from the catalog of Vulcraft. The designations are used for convenience only and other manufacturers, who make the same profile of deck and conform to the design standards, may be acceptable.

C. Submit the following shop drawings:

1. Erection drawings for all steel decking and accessories shall be approved by the Engineer prior to fabrication. Show support framing, openings, length, type, gage, zinc coating, markings of deck units and accessories, weld size, type, location and sequence.
2. Welding procedure for each type of weld prior to welding.
3. Qualification test reports bearing witness certification by an independent testing laboratory for each welder, welding operator, and tacker to be employed in the Work.
4. Manufacturer’s literature indicating steel deck load capacity for various deck styles, gages, spans, and depth indicated or specified.
5. Product data for mechanical fasteners to be used.

1.6 QUALITY CONTROL

A. Welding Qualification and Certification

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.
2. Each welder, tacker and welding operator shall be certified by test within the past six months to perform type of Work required in conformance with AWS Structural Welding Code. Testing shall be conducted and witnessed by an independent testing laboratory.
3. Maintain duplicate qualification and certifications records at the job site readily available for examination.

B. Steel decking shall comply with the specifications and tolerances of the Steel Deck Institute.

C. Replace or repair damaged galvanized material as directed by the Engineer at no additional cost to the Owner.

1.7 TESTING AND INSPECTION

A. Inspection, Testing and Quality Control: A statement of special inspections will be established by the registered design professional in responsible charge who will prepare a schedule of tests to be carried out by an independent testing agency. All costs for inspection and testing shall be borne by the Owner.

B. The materials and workmanship to be furnished under this Section shall be subject to inspection in the shop and field by the registered design professional in responsible charge and/or the testing agency. Such inspection shall not relieve the Contractor of his requirements to furnish materials and workmanship in accordance with requirements of the Contract Documents.

C. Access shall be provided for inspection of all facilities by the registered design professional in responsible change and/or the testing agency and the fabricator shall, when requested, aid the inspectors in carrying out their duties.

D. The testing agency will report test results promptly and in writing to Contractor and Architect/registered design professional in responsible charge.

E. Remove and replace work that does not comply with specified requirements.

F. Additional testing will be performed to check compliance of corrected work with specified requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with the general equipment stipulations Section and as specified herein.

B. Protect steel deck panels from damage at all times.

C. Use care during loading, transportation and unloading to prevent damage and injury to ends, sides and faces of panels.

D. Use nylon slings or padded cables for handling steel deck. Do not drop or drag materials.

E. Store steel deck and accessories off ground on platform or skid supports and protect from snow, rain and ground spatter.

1.9 USE OF DECK DURING ERECTION

A. Do not use steel deck for storage or Working platforms until permanently secured in position.

B. Do not allow construction loads to exceed carrying capacity of deck.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide steel deck, ridge plates, valley plates, closures, flashing and sump pans manufactured from galvanized steel sheet conforming to requirements of ASTM A 653 with a minimum yield stress of 40,000 psi.

B. Decking thickness shall be as indicated.

C. Anchor clips, vent clips, flexible closure strips, welding washers, flashing, saddle plates, sump pans, and other accessories shall be those types, sizes, and configurations recommended by the decking manufacturer, and shall be of the same material and finish as the deck units.

D. Flexible Cell Closures: Rubber, manufacturers standard.

E. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

F. Primer Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

2.2 STEEL DECK

A. Composite Steel Deck (typical, unless noted otherwise):

1. Composite decking to be furnished and installed shall be formed of 2 in. and 3 in. deep 18 gauge fluted, Type VLI decking as indicated on the drawings. All decking shall be galvanized steel sheet conforming to ASTM A653, G-60.
2. The formed composite decking shall have section properties not less than the following:

Type Deck	Section Modulus (Sp/Sn)	Moment of Inertia (Ip/In)
2" VLI (18 gauge)	0.485 $in.^3$/0.500 $in.^3$	0.558 $in.^4$/0.558 $in.^4$
3" VLI (18 gauge)	0.761 $in.^3$/0.794 $in.^3$	1.252 $in.^4$/1.252 $in.^4$

3. The above values are per foot of width and shall be determined by computing in accordance with the American Iron and Steel Institute's "Specifications" for the design of light gage cold-formed steel structural members.
4. Fabricate deck units with integral embossing or raised pattern to provide mechanical bond with concrete slabs.
5. Fabricate open-beam deck units with fluted section having interlocking side laps.

2.3 FABRICATION

A. Fabricate steel deck units in three span lengths or longer, except where one or two span lengths are necessitated due to interruptions at openings. Lap ends of units a minimum of 2 inches. Provide joints and laps shall be made over supporting members.

B. Locate openings for penetrating where indicated and provide support framing and edge reinforcement for all openings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Check all supporting elements for correct layout and alignment. Inform Contractor of any deficiencies and corrections required before securing deck units.

B. Do not place deck panels on concrete supporting structure until concrete has cured.

C. Remove debris from all surfaces to support steel deck.

D. Wire brush and paint any abraded or otherwise damaged areas of steel deck units with one coat of accepted galvanized repair paint such as SSPC-Paint 20 or MIL-P-21035, with a dry film containing a minimum of 94 percent zinc dust by weight.

3.2 INSTALLATION

A. Install decking and accessories on structural supports in conformance with Steel Deck Institute specifications, the Steel Deck Institute Manual of Construction with Steel Deck, in accordance with placement plans, manufacturer's printed installation instructions, and as indicated and specified.

B. Install temporary shoring before placing deck panels when required to meet deflection limitations.

C. Place deck panels on steel supports and adjust to final position with ends lapped over structural supports with a minimum end bearing of 1-½ inches. Do not stretch or contract side lap interlocks.

D. Permanently fasten deck panels to the structural supports immediately after placement.

E. Cut and neatly fit decking and accessories around openings and other penetrations.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck where approved by the Engineer of Record. Locate mechanical fasteners and install according to deck manufacturer's instructions.

3.3 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated as follows:

1. Weld Diameter: ¾ inch (19 mm), nominal.
2. Weld Pattern: 36/4 pattern.

B. Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 24 inches, with 1-1/2"-inch (38 mm) long minimum welds.

C. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. 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 decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

3.4 CUTTING AND FITTING

A. Steel deck erector shall perform all cutting and fitting of units as may be required.

B. Do not make holes that are not indicated on manufacturer's erection shop drawing without prior written approval of Engineer.

3.5 ACCESSORIES

A. Close open ends of all cell runs with cell closures at columns, openings, walls, etc. and where cells change direction.

B. Provide special end and side closures at pour stops and openings to act as edging.

C. Provide and weld flashings into position to close opening between steel deck units and columns, beams and girder.

D. Provide all other closures and flashings required for a complete installation and as recommended by deck manufacturer.

E. Fasten all closures, flashings, and sump pans by tack welding at a maximum spacing of 24 inches on center, but not less than one weldment on each corner.

3.6 PROTECTION

A. During installation, do not use the metal deck as a storage platform nor a working platform, until deck units have been fastened in position.

B. Do not overload the surface of installed metal decking during entire construction period.

C. Do not hang mechanical equipment or other loads, either temporarily or permanently, from decking.

D. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

E. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.7 CLEANING

A. Remove oil, grease, dirt and debris from deck and leave ready for work of next trade.

END OF SECTION

SECTION 054000

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Exterior non-load-bearing wall framing.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS for masonry shelf angles and connections.
2. Section 061600 - SHEATHING for exterior sheathing applied to cold-formed metal framing.
3. Section 092110 - GYPSUM BOARD ASSEMBLIES for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
4. Section 092120 - GYPSUM BOARD SHAFT-WALL ASSEMBLIES for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design framing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As required by code.
2. Deflection Limits: Design framing systems to withstand design loads within deflections greater than the following:

a. Exterior Non-Load-Bearing Framing:

1) Horizontal deflection of l/240 of the wall height for thin cladding systems.
2) Horizontal deflection of 1/600 of the wall height for masonry systems.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load, plus superimposed dead load, deflection of primary building structure.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and either ASTM C955, AISI S200 and ASTM C955 Section 8, or AISI S240, as required by governing Code.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. Shop drawings shall be signed and sealed by a professional engineer currently licensed in the Commonwealth of Massachusetts.

C. Delegated-Design Submittal: For framing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Miscellaneous structural clips and accessories.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements,

including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. California Expanded Metals Co. (CEMCO).
2. ClarkDietrich Building Systems.
3. EB Metal U.S.
4. Marino\WARE.
5. Telling Industries.
6. Super Stud Building Products Inc.

2.2 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with either ASTM C955, AISI S200 and ASTM C955 Section 8, or AISI S240, as required by governing Code for conditions indicated.

C. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G90.

D. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G90 (Z275).

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gauge).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ClarkDietrich Building Systems.
b. MarinoWARE, a division of Ware Industries.
c. The Steel Network, Inc.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, threaded carbon-steel bolts, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Acceptable Manufacturers: Kwik-Bolt 3 by Hilti, Inc., TruBolt Wedge Anchor by ITW Red Head or Power-Stud by Powers Fasteners.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Provide interior, field-applied primer with a VOC content of 250 g/L or less.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

1. Basis of Design: Sika; SikaGrout 212.
2. VOC Content: 0 g/L.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sill Sealer Gaskets: Closed-cell foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install sill sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 055000

METAL FABRICATIONS

(Part of Work of Section 050001 - MISCELLANEOUS AND ORNAMENTAL IRON,
Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Requirements for materials, hot-dip galvanizing, and shop-applied primers are included with each item as applicable.

1. Galvanized steel lintels with shop-applied primer at exterior locations.
2. Steel lintels with shop-applied zinc-rich primer at interior locations.
3. Steel support angles for elevator door sills.
4. Miscellaneous steel framing and supports:

    a. Galvanized steel framing and supports for mechanical and electrical equipment.
    b. Steel framing and supports for applications where framing and supports are not specified in other Sections; galvanized at exterior locations and in exterior walls.
    c. Prefinished slotted steel channel support framing.
    d. Steel framing and supports with shop-applied primer for countertops.

5. Ladders:

    a. Steel ladders to all roof levels, galvanized at exterior locations.
    b. Steel ladders at interior locations, shop-primed.
    c. Aluminum ships' ladders.

6. Miscellaneous steel trim including steel angle corner guards, steel edgings, and loading-dock edge angles, galvanized at exterior locations and in exterior walls.
7. Galvanized steel bollards with shop-applied primer.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 051200 - STRUCTURAL STEEL FRAMING for structural steel items.
2. Section 055100 - METAL STAIRS AND RAILINGS for steel stairs, handrails, and guardrails.
3. Section 099000 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders and miscellaneous framing and supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

1. For ladders exceeding 24 feet, include loads imposed by fall arrest system.

C. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

A. Product Data: For each product.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. Where fabrications are to receive sprayed-on fireproofing, include statement that primer is compatible with fireproofing proposed for use.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding certificates.

E. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated for this Project in material, design, and extent.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.3, "Structural Welding Code--Sheet Steel."

D. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304 at interior, Type 316L at exterior.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304 at interior, Type 316L at exterior.

E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

F. Steel Tubing: ASTM A 500, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

H. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.

1. Basis of Design: Unistrut Corp.

I. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.2 NONFERROUS METALS

A. Environmental Product Declarations (EPD): Industry-wide EPDs for aluminum extrusions, cold-rolled sheet, and hot-rolled sheet are available from the Aluminum Association.

B. Aluminum Plate and Sheet: ASTM B 209/B 209M, Alloy 6061-T6.

C. Aluminum Extrusions: ASTM B 221/221M, Alloy 6063-T6.

D. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

E. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Anchor Bolts: ASTM F 1554, Grade 36. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

C. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

D. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency. Anchors shall have an ICC-ES report with approval for use in cracked concrete.

1. Acceptable Manufacturers: Kwik-Bolt TZ by Hilti, Inc., TruBolt Wedge Anchor by ITW Red Head, Power-Stud+ by Powers Fasteners, or Strong Bolt by Simpson.

E. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts,

complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Urethane zinc-rich primer compatible with topcoat Specified in Section 099000 - PAINTS AND COATINGS.

1. Available Products: Tnemec; Series 394 PerimePrime, or approved equal.
2. VOC Content: 250 g/L or less.

D. Galvanizing Repair Paint: High-zinc-dust-content (95% by weight) paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Duncan Galvanizing; ZiRP.
   b. ZRC Worldwide; Galvilite Galvanizing Repair, low VOC type.
2. VOC Content: 250 g/L or less.

E. Isolation Coating (Bituminous Paint): ASTM D 1187, cold-applied asphalt emulsion, VOC compliant, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dayton Superior; 1107 Advantage Grout.
   b. Sika; SikaGrout 212.
2. VOC Content: 0 g/L.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts if units are installed after concrete is placed.

2.8 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.
3. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted brackets, made from same metal as ladder.
4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

2.9 METAL SHIPS' LADDERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers, pipe and tube railings, and textured treads, unless otherwise indicated. Provide brackets and fittings for installation.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Lapeyre Stair Inc.
b. Precision Ladders, LLC.
c. Vestil Manufacturing Company.

2.10 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.11 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Fabricate bollards for embedding in concrete.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.13 STEEL PRIMERS AND FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Urethane Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush Off Blast Cleaning."
3. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, embedded in concrete or masonry, unless otherwise indicated. Extend priming of partially embedded members to a depth of 2 inches.
4. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
5. Comply with SSPC-PA 2, "Measurement of Dry Coating Thickness with magnetic Gages."

B. Zinc-Rich Primer: Urethane zinc-rich primer compatible with topcoat Specified in Section 099000 - PAINTS AND COATINGS.

1. Available Products: Tnemec; Series 394 PerimePrime, or approved equal.
2. VOC Content: 340 g/L or less.

2.14 HOT-DIP GALVANIZING

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.
5. Fill vent holes after galvanizing, if applicable, and grind smooth.

2.15 HOT-DIP GALVANIZING AND FACTORY-APPLIED PRIMER

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.
5. Fill vent holes after galvanizing, if applicable, and grind smooth.

B. Factory-Applied Primer over Galvanized Steel: Provide factory-applied prime coat, certified OTC/VOC compliant less than 2.8 lbs/gal. and conforming to EPA and local requirements. Apply primer within 12 hours after galvanizing at the same galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Primer coat shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of architectural and structural elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments. Blast cleaning of the surface is unacceptable for surface preparation. Primer shall have a minimum two year re-coat window for application of finish coat. Coatings must meet or exceed the following performance criteria as stipulated by the coatings manufacturer:

1. Basis-of-Design: Primergalv by Duncan Galvanizing.

2. Abrasion Resistance: ASTM D 4060 (CS17 Wheel, 1,000 grams load).1kg load, 200 mg loss.
3. Adhesion: ASTM D4541, 1050 psi.
4. Corrosion Weathering: ASTM D5894, 13 cycles, 4,368 hours; rating 10 per ASTM D714 for blistering and rating 7 per ASTM D610 for rusting.
5. Direct Impact Resistance: ASTM D2794, 160 in. lbs.
6. Flexibility: Method: ASTM D522, 180 degree bend, 1 inch mandrel, passes.
7. Pencil Hardness: ASTM D3363, 3B.
8. Moisture Condensation Resistance: ASTM D4585, 100 degrees F, 2000 hours; passes, no cracking or delamination.
9. Dry Heat Resistance: Method: ASTM D2485, 250 degrees F.
10. Warranty: Provide galvanizer's warranty that materials will be free from 10 percent or more visible rust for a period of 20 years.

2.16 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coat complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of steel that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of isolation coating.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING PIPE BOLLARDS

A. Anchor bollards by embedding in concrete in accordance with Civil Drawings unless otherwise indicated.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touch-Up and Repair for Galvanized Surfaces: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.

1. For galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A 780, modified to 95 percent zinc in dry film. Thickness of applied galvanizing repair paint shall be not less than coating thickness required by ASTM A 123 or A 153 as applicable. Touch-up of galvanized surfaces with silver paint, brite paint, or aluminum paints is not acceptable.
2. For factory-applied finish coatings, field-touch-up shall be performed by factory approved personnel. Touch-up shall be such that repair is not visible from a distance of 6 feet.
3. A touch-up repair kit or touchup instructions shall be provided to the Owner for each type of factory-applied finish.

END OF SECTION

SECTION 055100

METAL STAIRS AND RAILINGS

(Part of Work of Section 050001 - MISCELLANEOUS AND ORNAMENTAL IRON,
Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Steel stairs with concrete filled treads.
2. Steel railings, handrails and guardrails, interior and exterior.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS for metal treads and nosings not installed in metal stairs.
2. Section 061000 - ROUGH CARPENTRY for wood blocking for anchoring railings.
3. Section 092110 - GYPSUM BOARD ASSEMBLIES for metal backing for anchoring railings.
4. Section 099000 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design stairs and railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load and Concentrated Loads: As required by Code.
2. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
3. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and Code required loads and stresses within limits and under conditions indicated.

D. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to Code.

1.4 SUBMITTALS

A. Product Data: For each product.

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Provide templates for anchors and bolts specified for installation under other Sections.
2. Shop drawings shall be signed and sealed by a professional engineer currently licensed in the Commonwealth of Massachusetts.

C. Delegated-Design Submittal: For stairs and railings indicated to comply with performance requirements and design criteria, including structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding certificates.

E. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs and railings that are similar to those indicated for this Project in material, design, and extent.

C. Installer Qualifications: Fabricator of products.

D. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Stairs: Commercial class.

E. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items

with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

E. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial steel, Type B, or structural steel, Grade 33, unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 099000 - PAINTING AND COATING.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Provide interior, field-applied primer with a VOC content of 250 g/L or less.

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Provide interior, field-applied primer with a VOC content of 250 g/L or less.

E. Isolation Coating (Bituminous Paint): ASTM D 1187, cold-applied asphalt emulsion, VOC compliant, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

1. Available Products: Sika; SikaGrout 212, or approved equal.
2. VOC Content: 0 g/L.

G. Concrete Materials and Properties: Comply with requirements in Section 033000 - CAST-IN-PLACE CONCRETE for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding, unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously, unless otherwise indicated.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Comply with “Guideline 1: Joint Finishes”, by National Ornamental & Miscellaneous Metals Association (NOMMA), as follows:

1. Typical Railing: Type 2 or better, unless otherwise indicated.
2. Service Stair Railing: Type 3 or better, unless otherwise indicated.
3. Ornamental Railing: Type 1.

I. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alfab, Inc.
2. American Stair, Inc.
3. McGregor Industries, Inc..

B. Stair Framing:

1. Fabricate stringers of hollow steel sections. Provide closures for exposed ends of stringers.
2. Construct platforms of hollow steel section headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board or shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch.

1. Steel Sheet: Uncoated hot-rolled steel sheet, unless otherwise indicated.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
3. Shape metal pans to include nosing integral with riser.
4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.7 STEEL RAILINGS

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

C. Form changes in direction of railings as detailed on the Drawings.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding, unless otherwise indicated.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
4. Handrails: Galvanizing shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of the railings.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

1. Exterior Stairs (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Place and finish concrete fill for treads and platforms to comply with Section 033000 - CAST-IN-PLACE CONCRETE.

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

3.2 INSTALLING STEEL RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
3. For hollow masonry anchorage, use toggle bolts.
4. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 061000

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Framing with dimension lumber.
2. Wood blocking, cants, and nailers.
3. Plywood backing panels.
4. Framing with engineered wood products.
5. Rough hardware and fasteners.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042000 - UNIT MASONRY for wood nailers and blocking built into masonry.
2. Section 061600 - SHEATHING for gypsum sheathing.
3. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for interior woodwork not specified in this Section.
4. Section 092110 - GYPSUM BOARD ASSEMBLIES for sheet metal backing.

1.3 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Provide plans and details for members and components, showing layouts, materials and dimensions, as well as construction and application details.

2. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
3. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

C. Special Tests and Inspections: Refer to Specification Section 01 45 33 – Code Required Special Inspections and Procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Plywood Panels:

1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
3. Factory mark panels according to indicated standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

    a. Use Borate or Copper Azole treatments. Product shall not contain creosote, arsenic or pentachlorophenol.

2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 18 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete in exterior walls.

E. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hoover Treated Wood Products; PyroGuard.
2. Koppers Performance Chemicals; LifeWood MicroPro Treatment.
3. Sustainable Northwest Wood; Pressure Treated Wood with Copper Azule.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: For all interior use materials, and where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
5. Product shall not contain creosote, arsenic or pentachlorophenol.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Technologies Boralife Inc.; Boraflame.

2.4 MISCELLANEOUS LUMBER

A. General: Provide FRTW lumber for support or attachment of other construction, including, but not limited to, the following: Rooftop equipment bases and support curbs, blocking, cants, nailers, furring and grounds.

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 15 percent moisture content.

2.5 PANEL PRODUCTS

A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch.

B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5; except provide stainless steel complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2, where in contact with pressure-preservative treated wood or when exposed to exterior conditions.

2.7 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

E. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick.

F. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36 inches long.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

B. Adhesive, Including Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Henkel Corp.; Loctite PL Premium Polyurethane Construction Adhesive.
    b. Henkel Corp.; OSI SF450 Heavy Duty Subfloor Construction Adhesive.

2. Low-Emitting Materials: Provide adhesives in compliance with the 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."
3. VOC Content: 70 g/L or less.
4. Do not use adhesives that contain urea formaldehyde.
5. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

D. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

G. Do not splice structural members between supports unless otherwise indicated.

H. Securely attach carpentry work as indicated and according to applicable codes and the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

I. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.

J. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

K. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal-thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install as required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide 2-by-6-inch nominal-size wood studs spaced 16 inches o.c. unless otherwise indicated.
2. For interior partitions and walls, provide 2-by-6-inch nominal-size wood studs spaced 16 inches o.c. unless otherwise indicated.
3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

D. Provide diagonal bracing in walls, at locations indicated, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal-size boards, let-in flush with faces of studs.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 061600

SHEATHING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Gypsum sheathing attached to cold-formed metal framing members at exterior wall.
2. Plywood sheathing.
3. Composite nail base insulated roof sheathing.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042000 - UNIT MASONRY for masonry-veneer anchors and insulation in cavity wall construction.
2. Section 054000 - COLD-FORMED METAL FRAMING for metal framing at exterior wall.
3. Section 061000 - ROUGH CARPENTRY for plywood backing panels.
4. Section 072700 - AIR BARRIERS for modified bituminous sheet membrane over gypsum sheathing and membrane flashing.
5. Section 076200 - SHEET METAL FLASHING AND TRIM for flashing applied to gypsum sheathing.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. Product Data: For each product specified.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Power-driven fasteners.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each gypsum sheathing product through one source from a single manufacturer.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

C. Fire-Resistance-Rated Assemblies: Where gypsum sheathing boards are part of fire-resistance-rated assemblies, provide assemblies as follows:

1. Assemblies comply with requirements of fire-response-tested assemblies indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual"; or by design designations in UL's "Fire Resistance Directory" or in certification listings of another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Fire-resistance ratings were determined by fire-response testing assemblies according to ASTM E 119.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles, each bearing brand name and identification of manufacturer.

B. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Neatly stack gypsum sheathing board flat on leveled supports off the ground, under cover, and fully protected from weather.

1.7 SEQUENCING AND SCHEDULING

A. Sequence installing sheathing with installing exterior cladding to comply with requirements indicated below:

1. Do not leave nail base sheathing board exposed to weather.
2. Do not leave glass-mat gypsum sheathing board exposed to weather for more than 180 days.

PART 2 - PRODUCTS

2.1 GLASS-MAT GYPSUM SHEATHING BOARD

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; GlasRoc.
b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond, e^{2}XP.
d. USG Corporation; Securock.

2. Type and Thickness: 5/8 inch, Type X.
3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

2.2 WOOD PANEL PRODUCTS

A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior and Interior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:

1. Roof sheathing.

2.5 PLYWOOD SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing.

1. Span Rating: APA Rated. Not less than 40/20.
2. Nominal Thickness: Not less than 5/8 inch.
3. Edges: Tongue and groove.

2.6 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

A. Oriented Strand Board (OSB): DOC PS 2.

B. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C 1289, Type II, Class 1, with oriented strand board adhered to spacers on one face.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Roofing Corporation.
b. Cornell Corporation.
c. Dow Chemical Company (The).
d. GAF.
e. Hunter Panels.
f. Johns Manville; Berkshire Hathaway Inc.
g. Rmax, Inc.

2. Polyisocyanurate-Foam Thickness: As indicated on Drawings.
3. Oriented-Strand-Board Nominal Thickness: 7/16 inch.
4. Spacers: Wood furring strips or blocks not less than 3/4 inch thick and spaced not more than 16 inches o.c.

C. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153 or of Type 304 stainless steel.

D. Screws for Fastening Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing to Wood Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.7 FASTENERS

A. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Coordinate sheathing installation with flashing and joint sealant installation so these materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.

B. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

A. General: Install gypsum sheathing to comply with GA-253 and manufacturer's written instructions.

B. Cut boards at penetrations, edges, and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8-inch setback where non-load-bearing construction abuts structural elements.

C. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

D. Vertical Installation: Install 48-inch- wide gypsum sheathing boards vertically with vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud:

1. Perimeter: 6 inches on center.
2. Field: 8 inches on center.

3.3 NAILBASE SHEATHING INSTALLATION

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following, as applicable:

1. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
2. ICC-ES evaluation report for fastener.

D. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

E. Ensure ventilation path remains unobstructed.

3.4 PLYWOOD SHEATHING INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Roof Sheathing:

a. Orient face grain perpendicular to framing.
b. Fasten sheathing to each framing member using 10d common nails at maximum 6 inch spacing along intermediate supports.
c. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

SECTION 064020

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Wood casework and built-ins.
2. Plastic-laminate casework.
3. Solid-surfacing-material countertops.
4. Closet and utility shelving.
5. Shop finishing of interior woodwork.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 SUBMITTALS

A. Product Data: For each type of product specified, including casework hardware and accessories, and finishing materials and processes.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

a. Provide schedule of blocking required to support the Work of this Section.

2. Show locations and sizes of cutouts and holes for plumbing fixtures, electrical components and other items installed in architectural woodwork.
3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Verification:

1. Lumber with or for transparent finish, not less than 5 inches wide by 12 inches long for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.

    a. Submit step-type range sample sets of factory finished plywood and factory finished solid wood in size illustrating wood grain and specified finish, including edge banding detail and any veneer or solid edge glue joints.
    b. Submit one leaf for every 1000 gross square foot of veneer required.

3. Plastic laminates, 8 by 10 inches for each type, color, pattern, and surface finish, with 1 sample applied to core material, and specified edge material applied to 1 edge.
4. Solid-surfacing materials, 6 inches square.

D. Qualification Data: For Installer and fabricator.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with blueprint-matched wood veneers and components.

C. Quality Standard: Unless otherwise indicated, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards," latest edition, including errata, for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1. The HVAC systems as specified elsewhere may not provide for humidity controls. The expected ranges of relative humidity are expected to be as high as 55% to a low of uncontrolled during the heating system. Comply with AWS Section 2, Care and Storage.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 MATERIALS

A. General: Provide materials that comply with requirements of AWI/AWMAC/WI's "Architectural Woodwork Standards" for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Environmental Product Declarations (EPD): Industry-wide EPDs for wood products and plastic laminates are available from the American Wood Council and Canadian Wood Council.

C. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

D. Wood Veneers and Lumber: Provide AWI Custom Grade materials and workmanship, unless otherwise indicated. For species not listed in the AWS comply with the following:

1. Provide AWI Lumber Grade 1 and AWI Grade A Veneer, book-matched, minimum 6 inch face veneer width. Kiln dry to 6-8 percent moisture content. Components shall be free of defects and sapwood. Match adjacent pieces for color and grain pattern.

2. Single-Source Requirement for Wood Veneers and Solids: Intent is to provide wood which matches as closely as possible throughout the project. Provide wood veneers and solids from the same distributor, and from the same flitches and solids sources to the greatest extent possible.

E. Wood Species and Cut for Transparent Finish: As selected by the Architect.

1. Architect's control samples for transparent finish, veneer grain and figure characteristics are available for review at the office of the Architect.
2. Veneer Matching Requirements:

    a. Matching Between Adjacent Veneer Leaves: Book match and architectural end match.
    b. Matching Within Individual Panel Faces: Balance and Center Match.
    c. Method of Matching Panels: Blueprint-matched panels and components.

F. Wood Species for Opaque Finish: Any closed-grain hardwood.

G. Composite Wood Products: Comply with the following:

1. Composite Wood, General: CARB II compliant or made with binder containing no added formaldehyde (NAF).
2. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade MD.
3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1, Medium Density Overlay (MDO).
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

    a. Resin impregnated paper backs are not permitted. Backs shall be of compatible hardwood species and cut. Contact adhesive is not permitted.

H. High-Pressure Decorative Plastic Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:

    a. Abet Laminati, Inc.
    b. Arborite; a division of Wilsonart.
    c. Formica Corporation.
    d. Lamin-Art; a division of Wilsonart.
    e. Nevamar, Panolam, and Pionite; divisions of Panolam Surface Systems.
    f. Wilsonart LLC.

I. Solid-Surfacing Material, Quartz-Agglomerate Type: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin complying with ISFA-2.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CaesarStone.
    b. Cosentino USA; Silestone.
    c. Dal-Tile; ONE Quartz Surfaces.

d. DuPont; Corian Quartz.
e. Porcelanosa; Krion Quartz Surfaces.

J. Tempered Float Glass for Casework: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 1/4 inch (6 mm) thick, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:

1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
2. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
3. Kiln-dry materials before and after treatment to levels required for untreated materials.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

1. Fire-Retardant Fiberboard and Particleboard: Provide five ply construction with crossbands to prevent any ammonia fuming from the core to the face veneers.

2.4 CASEWORK HARDWARE AND ACCESSORIES

A. General: Provide casework hardware and accessory materials associated with architectural casework, except for items specified in Section 087100 - DOOR HARDWARE.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602,100 degrees of opening, self-closing.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Catches: Push-in magnetic catches, BHMA A156.9, B03131.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112.

F. Drawer Slides: BHMA A156.9, Bottom edge mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated-steel with steel ball-bearings; of the following grades:

1. Box Drawer Slides: Grade 1.
2. File Drawer Slides: Grade 1HD-100.
3. Pencil Drawer Slides: Grade 2.
4. Keyboard Slides: Grade 1.
5. Trash Bin Slides: Grade 1HD-100.

G. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063. Accommodate large doors as indicated on Drawings.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Grommets for Cable Passage through Countertops: Molded-plastic grommets and matching plastic caps with slot for wire passage.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.
2. Satin Aluminum, Clear Anodized: BHMA 628.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Installation Adhesives and Wood Glues: Formulations approved for use indicated by adhesive manufacturer.

1. Low-Emitting Materials: Provide adhesives in compliance with the 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. VOC Limits: Use installation adhesives that comply with the following limits for VOC content:

a. Wood Glues: 30 g/L.
b. Contact Adhesives: Not permitted on the Project without Architect’s prior approval.

3. Do not use adhesives that contain urea formaldehyde.
4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

2.6 FABRICATION, GENERAL

A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

B. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Casework and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.

D. Complete fabrication, including assembly, finishing, 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.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, 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.

1. Seal edges of openings in countertops with a coat of varnish.

F. Install glass to comply with applicable requirements in Section 088000 - GLAZING and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.7 WOOD CASEWORK FOR TRANSPARENT FINISH

A. Grade: Custom.

B. AWI Type of Casework Construction: Flush overlay.

C. Wood Species and Cut for Exposed Surfaces: As specified hereinabove.

1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
2. Matching of Veneer Leaves: Book match.
3. Vertical Matching of Veneer Leaves: End match.
4. Veneer Matching within Panel Face: Running match.
5. Veneer Matching within Room: Provide casework veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.

D. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
2. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.

3. Drawer Bottoms: Hardwood plywood.

2.8 WOOD CASEWORK FOR OPAQUE FINISH

A. Grade: Custom.

B. AWI Type of Casework Construction: Flush overlay.

C. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.

D. Panel Product for Exposed Surfaces: Medium-density overlay.

E. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Match materials indicated for exposed surfaces.
2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

2.9 PLASTIC-LAMINATE CASEWORK

A. Grade: Custom.

B. AWI Type of Casework Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from laminate manufacturer's full range.

2.10 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from manufacturer's full range.

D. Edge Treatment: As indicated.

E. Core Material: Exterior-grade plywood.

F. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

2.11 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Custom.

B. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. As selected by Architect from manufacturer's full range.

C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with loose backsplashes for field application.
3. For engineered quartz and natural stone countertops, comply with OSHA 1926.1153 - Respirable Crystalline Silica. Do not use dry-cutting methods.

D. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.12 CLOSET AND UTILITY SHELVING

A. Grade: Custom.

B. Shelf Material: 1-inch plastic laminate-faced panel product with solid-lumber edge.

C. Cleats: 3/4-inch solid lumber.

D. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel.

E. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.

F. Clothes Rods: 1-5/16-inch-diameter, chrome-plated-steel tubes.

1. Rod Flanges: Chrome-plated steel.

2.13 SHOP FINISHING

A. General: Comply with AWI/AWMAC/WI's "Architectural Woodwork Standards" for factory finishing.

1. Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

C. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen with sheen measured on 60-degree gloss meter per ASTM D 523:

1. Grade: Same as item to be finished.
2. AWS Finish System 5: Conversion varnish.
3. Washcoat for Closed-Grain Woods: Apply washcoat sealer to woodwork made from closed-grain wood before staining and finishing
4. Staining: Match approved sample for color.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Sheen: Satin, 30-50 gloss units.
7. Effect: Partially filled pore.

D. Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523.

1. Grade: Same as item to be finished.
2. AWS Finish System 5: Conversion varnish.
3. Color: As selected by Architect from manufacturer's full range.
4. Sheen: Satin, 30-50 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

G. Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install casework with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Attach casework to walls with mechanical fasteners. Do not use adhesives, so that casework may be removed and salvaged in the future.

H. Countertops: Anchor securely by screwing through corner blocks of base casework or other supports into underside of countertop.

1. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches and to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Section 079200 - JOINT SEALANTS.

I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 066400

FRP PANELING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood furring for installing plastic paneling.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Crane Composites.
2. Marlite.
3. Nudo Products, Inc.

2.2 PLASTIC SHEET PANELING

A. General: Gelcoat-finished, glass-fiber reinforced plastic (FRP) panels complying with ASTM D 5319.

1. Nominal Thickness: Not less than 0.075 inch.
2. Surface Finish: As selected by Architect.
3. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer for substrate indicated.

1. Low-Emitting Materials: Provide adhesives in compliance with the 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. VOC Content: 50 g/L or less.
3. Do not use adhesives that contain urea formaldehyde.
4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

E. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 - JOINT SEALANTS.

1. Low-Emitting Materials: Provide adhesives in compliance with the 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. VOC Content, Architectural Sealants: 250 g/L or less.
3. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels and so that trimmed panels at corners are not less than 12 inches wide.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive.

D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 066600

FIBERGLASS SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Custom fiberglass specialties, at exterior locations.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 051200 - STRUCTURAL STEEL FRAMING for sequencing to support cupola.
2. Section 061000 - ROUGH CARPENTRY for wood furring, grounds, nailers, and blocking.
3. Section 077100 - ROOF SPECIALTIES for gutters.
4. Section 079200 - JOINT SEALANTS for field-applied sealants not otherwise specified in this Section.
5. Section 099000 - PAINTING AND COATING for field-finishing work of this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type, color, texture, and pattern required.

1. 12-inch-long-by-actual-width Sample of trim.
2. 12-inch- long-by-actual-width Samples of accessories.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fiberglass specialties from single manufacturer.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with exterior fiberglass specialties installation only if substrate is completely dry and if existing and forecasted weather conditions permit exterior fiberglass specialties to be installed according to manufacturer's written instructions.

1.6 SEQUENCING

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

PART 2 - PRODUCTS

2.1 FIBERGLASS SPECIALTIES

A. Available Manufacturers: Provide materials that meet or exceed specified requirements from one of the following manufacturers, or Architect approved equals:

1. Architectural Fiberglass, Inc.
2. Custom Castings Northeast.
3. Duro Fiber Company.
4. Edon Corporation.
5. Wilson Composites.

B. Materials: Pre-engineered molded fiberglass reinforced polyester fabrications. Surface coat shall be a polyester gelcoat of 0.015 to 0.025 in. thickness, with UV stabilizers; pigmented colors to match Architect's sample. Products shall be for exterior use.

1. Provide all connection and erection materials needed, including attachments to building structure, without visibility on the finish face. Metal shall be stainless steel or zinc coated, cadmium plated, or hot-dip galvanized.
2. Adhesives: As recommended by manufacturer.
3. Joint Sealant: Comply with Section 079200 - JOINT SEALANTS.

C. Scope: Fiberglass reinforced polyester work includes, but is not limited to:

1. Cornices and trim.
2. Cupolas.

D. Fabricate shapes from molds to conform to the dimensions and profiles shown. Accurately provide thicknesses indicated on the approved shop drawings.

1. Length per alignments shown on drawings.

E. Fabrication Tolerances: Fabricate units to comply with the following tolerances:

1. Dimensional: + 1/8".
2. Warp or Bow: + 1/16" per foot, maximum of 1/4" total.

F. Finishes, Colors and Textures: Provide colors and textures to match the approved samples. Directional grain, visible fibers, pinholes in the gelcoat and other visible defects will not be accepted.

2.2 ACCESSORIES

A. Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content, per Section 061000 - ROUGH CARPENTRY.

B. Flashing: Provide metal flashing complying with Section 076200 - SHEET METAL FLASHING AND TRIM at window and door heads and where indicated.

C. Fasteners: Stainless steel Type 300 series, manufacturer's recommended fastener types.

1. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

A. Install fiberglass specialties in accordance with the manufacturer's recommendations. Repair any blemishes to the satisfaction of the Architect.

B. Install joint sealants as specified in Section 079200 - JOINT SEALANTS and to produce a weathertight installation.

3.4 CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 070001

WATERPROOFING, DAMPPROOFING AND CAULKING

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 070001 – WATERPROOFING, DAMPPROOFING AND CAULKING.

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-001 TYPICAL EXTERIOR ASSEMBLIES
A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-110 ROOF PLAN
A-300 EXTERIOR ELEVATIONS
A-301 EXTERIOR ELEVATIONS
A-302 PROPOSED 3D VIEWS

A-400 BUILDING SECTIONS
A-401 BUILDING SECTIONS
A-402 BUILDING SECTIONS
A-403 BUILDING SECTIONS
A-500 WALL SECTIONS
A-501 WALL SECTIONS
A-502 WALL SECTIONS
A-503 WALL SECTIONS
A-520 SECTION DETAILS
A-521 SECTION DETAILS
A-522 SECTION DETAILS
A-523 SECTION DETAILS
A-530 PLAN DETAILS
A-531 PLAN DETAILS
A-532 PLAN DETAILS
A-600 ELEVATOR DRAWINGS
A-800 DOOR SCHEDULE AND DETAILS
A-801 DOOR DETAILS
A-802 DOOR DETAILS
A-810 WINDOW SCHEDULE AND DETAILS
A-811 WINDOW DETAILS

S-010 TYPICAL FOUNDATION DETAILS - 1
S-011 TYPICAL FOUNDATION DETAILS - 2
S-012 TYPICAL FOUNDATION DETAILS - 3
S-020 TYPICAL DETAILS - 1
S-021 TYPICAL DETAILS - 2
S-022 TYPICAL DETAILS - 3
S-023 TYPICAL DETAILS - 4
S-024 TYPICAL DETAILS - 5
S-100 FOUNDATION PLAN
S-110 FIRST FLOOR FRAMING PLAN
S-200 FOUNDATION SECTIONS AND DETAILS
S-201 FOUNDATION SECTIONS AND DETAILS

1.2 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. All Work of Section 071400 - FLUID-APPLIED WATERPROOFING
2. All Work of Section 071610 - CRYSTALLINE WATERPROOFING
3. All Work of Section 072700 - AIR BARRIERS
4. All Work of Section 079200 - JOINT SEALANTS

END OF SECTION

SECTION 070002

ROOFING AND FLASHING

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 070002 – ROOFING AND FLASHING

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-001 TYPICAL EXTERIOR ASSEMBLIES
A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-110 ROOF PLAN
A-300 EXTERIOR ELEVATIONS
A-301 EXTERIOR ELEVATIONS
A-302 PROPOSED 3D VIEWS
A-400 BUILDING SECTIONS

A-401 BUILDING SECTIONS
A-402 BUILDING SECTIONS
A-403 BUILDING SECTIONS
A-500 WALL SECTIONS
A-501 WALL SECTIONS
A-502 WALL SECTIONS
A-503 WALL SECTIONS
A-520 SECTION DETAILS
A-521 SECTION DETAILS
A-522 SECTION DETAILS
A-523 SECTION DETAILS
A-600 ELEVATOR DRAWINGS
A-800 DOOR SCHEDULE AND DETAILS
A-801 DOOR DETAILS
A-802 DOOR DETAILS
A-810 WINDOW SCHEDULE AND DETAILS
A-811 WINDOW DETAILS

1.2 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. All Work of Section 073113 - ASPHALT SHINGLES
2. All Work of Section 075400 - THERMOPLASTIC MEMBRANE ROOFING
3. All Work of Section 076200 - SHEET METAL FLASHING AND TRIM

END OF SECTION

SECTION 071400

FLUID-APPLIED WATERPROOFING

(Part of Work of Section 070001 - Waterproofing, Dampproofing and Caulking, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Cold fluid-applied waterproofing membrane.
2. Molded sheet drainage panels.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 072100 - THERMAL INSULATION for insulation at foundations and under slabs.
2. Section 079200 - JOINT SEALANTS for joint-sealant materials and installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Samples: For the following products:

1. 12-by-12-inch square of waterproofing and reinforcing strip.
2. 12-by-12-inch square of drainage panel.

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

D. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is acceptable to waterproofing manufacturer to install manufacturer's products.

B. Source Limitations: Obtain waterproofing materials, protection course, and molded-sheet drainage panels through one source from a single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty insulation will retain 80 percent of original published thermal value.
2. Warranty Period: Five years from date of Substantial Completion.

B. Special Installer's Warranty: Signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED WATERPROOFING

A. Fluid-Applied Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.

1. Basis of Design: W. R. MEADOWS; HYDRALASTIC 836 SL.

B. Performance Requirements: Waterproofing membrane shall have the properties as determined by laboratory testing:

1. Solids content by weight, ASTM C2369: 96 percent.
2. Tensile Strength, ASTM D412: 350 psi.
3. Elongation at break, ASTM D412: 500 percent.
4. Water Vapor Transmission, ASTM E96 (Method BW): 0.1 perm in.
5. Shore 00 Hardness, ASTM D2240: Minimum 76.
6. VOC, ASTM D2369: 47 g/L

2.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

B. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

C. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

2.3 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to 1 side with a polymeric film bonded to the other side of a 3-dimensional (studded), nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Hydrotech, Inc.; Hydrodrain 420.
b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRAIN 6200 series.
c. GCP Applied Technologies (formerly W.R. Grace); Hydroduct 220 vertical, 660 horizontal.
d. Henry Company; DB 220 vertical, DB 650 horizontal.
e. Sika Sarnafil Inc.; Drainage Panel 900 series.
f. Tremco Inc. TREMDrain 1000 or TREMDrain 2000.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.

    a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

3.4 MEMBRANE APPLICATION

A. Apply waterproofing according to ASTM C 898 and manufacturer's written instructions.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify wet film thickness of waterproofing every 100 sq. ft.

3.5 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.6 CLEANING AND PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed waterproofing from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 071610

CRYSTALLINE WATERPROOFING

(Part of Work of Section 070001 - WATERPROOFING, DAMPPROOFING AND CAULKING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Crystalline waterproofing for the following applications.

a. Elevator pits.
b. Sump pits.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 033000 - CAST-IN-PLACE CONCRETE for concrete substrate and finishing concrete walls and slabs to receive waterproofing.
2. Section 079200 - JOINT SEALANTS for elastomeric and preformed sealants in concrete walls and floors.

1.3 SUBMITTALS

A. Product Data: Include manufacturer’s installation instructions and general recommendations for waterproofing applications, substrate preparation, project specific construction details, and material descriptions and installation instructions for crystalline waterproofing.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions and warranty requirements.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after concrete substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of crystalline waterproofing that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to maintain watertight conditions within specified warranty period.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Crystalline Waterproofing:

a. Anti-Hydro International, Inc.; Hydro Cap.
b. Conproco Corp.; Super Seal.
c. Tamms Industries, Inc.; Hey'Di K-11.
d. ThoRoc, Div. of ChemRex; Tegraproof.
e. Vandex International Ltd.; Vandex Super.
f. W.R. Meadows; Cem-Kote CW Plus.
g. Xypex Chemical Corporation; Xypex.

2.2 MATERIALS

A. Crystalline Waterproofing: A prepackaged, proprietary blend of Portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates by capillary action into concrete and reacts chemically with free lime in the presence of water to develop crystalline growth within concrete capillaries to produce an impervious, dense, waterproof concrete with properties meeting or exceeding the following criteria:

1. Permeability: 0 for water at 33 feet when tested according to CE CRD-C 48.
2. Compressive Strength: Minimum 3000 psi when tested according to ASTM C 109/C 109M.

B. Patching Compound: Cementitious waterproofing and repair mortar for filling and patching tie holes, honeycombs, reveals, and other imperfections; with properties meeting or exceeding the following criteria:

1. Compressive Strength: 7600 psi at 28 days when tested according to ASTM C 109/C 109M.
2. Flexural Strength: 710 psi at 28 days when tested according to ASTM C 348.
3. Shrinkage: Minus 0.093 percent at 28 days and plus 0.073 percent at 90 days when tested according to ASTM C 596.

C. Plugging Compound: Cementitious compound with hydrophobic properties; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead and horizontal surfaces not exposed to vehicular traffic); with properties meeting or exceeding the following criteria:

1. Permeability: 30 feet when tested according to CE CRD-C 48.
2. Compressive Strength: 6000 psi at 28 days when tested according to ASTM C 109/C 109M.
3. Flexural Strength: 1000 psi at 28 days when tested according to ASTM C 348.
4. Bond Strength: 300 psi at 14 days when tested according to ASTM C 321.

D. Water: Potable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Conditions: Examine substrates, with Applicator present, where waterproofing is to be applied.

1. Proceed with application only after unsatisfactory conditions have been corrected.
2. Notify Architect in writing of active leaks or structural defects that would affect system performance.

3.2 PREPARATION

A. Protect other work from damage from cleaning, preparation, and application of crystalline waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

B. Stop active water leaks according to waterproofing manufacturer's written instructions.

C. Repair damaged or unsatisfactory concrete according to manufacturer's written instructions.

D. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, curing compounds, and form-release agents to ensure that waterproofing bonds to concrete surfaces.

1. Clean concrete surfaces according to ASTM D 4258.

a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.

2. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

3. Cracks: Clean and fill cracks according to waterproofing manufacturer’s written instructions.

3.3 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application.

1. Dampen surface with water and maintain damp condition until applying waterproofing.
2. Apply waterproofing to negative-side surfaces.
3. Number of Coats: Two coats.
4. Dampen surface between coats.

B. Final Coat Finish: Smooth

C. Moist-cure waterproofing for three days immediately after application has set, followed by two days of air drying as recommended in writing by manufacturer.

D. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:

1. Onto columns integral with treated walls.
2. Onto every substrate in areas indicated for treatment, including pipe trenches, pits, and sumps.

3.4 CLEANING AND PROTECTION

A. Protect applied crystalline waterproofing from rapid drying, severe weather exposure, and water accumulation. Maintain completed Work in moist condition for not less than three days by procedures recommended in writing by waterproofing manufacturer. Protect waterproofing from temperatures below 36 deg F.

B. Cleaning: Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures.

C. Protection: Take measures to protect completed crystalline waterproofing coating from damage after application.

3.5 FIELD QUALITY CONTROL

A. Inspection: Engage manufacturer's representative to inspect completed application and to provide a written report that application complies with manufacturer's written instructions.

END OF SECTION

SECTION 072100

THERMAL INSULATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Rigid insulation under slabs-on-grade and at perimeter foundation walls.
2. Mineral-wool insulation at cavity walls.
3. Mineral-wool blanket insulation.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 033000 - CAST-IN-PLACE CONCRETE for underslab vapor barrier.
2. Section 061600 - SHEATHING for insulated nail base sheathing.
3. Section 072700 - AIR BARRIERS for air and vapor barrier membrane.
4. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for roofing insulation.
5. Section 092110 - GYPSUM BOARD ASSEMBLIES for acoustic insulation in gypsum board assemblies.
6. Division 22 - PLUMBING for plumbing insulation.
7. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for mechanical insulation.

1.3 SUBMITTALS

A. Product Data: Manufacturer product data, installation instructions, performance criteria, and product limitations for each type of product indicated.

B. Qualification Data: For Testing Agency.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Testing Agency Qualifications: An independent agency qualified as a “Certified Infrared Thermographer” per ASNT SNT-TC-1A guidelines, Level I certification minimum.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store in a dry and secure location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver materials to Project site before installation time.
3. Complete installation and concealment of materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 FOUNDATION WALL AND UNDER SLAB INSULATION

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. DuPont (formerly Dow Chemical); Reduced GWP Styrofoam series (gray color).
2. Sika Corporation; Sarnatherm XPS
3. Owens Corning; Foamular NGX (Next Generation Extruded) series.

B. Extruded-Polystyrene (XPS) Board Insulation: ASTM C 578, square edged of type, density, and compressive strength indicated below:

1. For vertical applications, Type IV, 1.6-lb/cu. ft. minimum density and 25-psi minimum compressive strength.
2. For horizontal applications, pedestrian traffic, Type VII, 2.2-lb/cu. ft. minimum density and 60-psi minimum compressive strength.
3. For horizontal applications, vehicular traffic, Type V, 3-lb/cu. ft. minimum density and 100-psi minimum compressive strength.
4. Thermal Resistivity (R-value): 5.0 per inch.
5. Blowing Agent: Honeywell; Solstice Liquid Blowing Agent, low global warming potential (GWP) hydrofluoro-olefin (HFO), or approved equal.

    a. Other insulation manufacturers may be considered, if they have adopted the HFO blowing agents by start of construction.

6. Recycled Content: 20 percent min.

C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.2 CAVITY WALL INSULATION, MINERAL-WOOL BOARD

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Isolatek International.

2. Owens Corning; Thermafiber.
3. Rockwool (formerly Roxul).

B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612, Type IVB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Nominal density of 4 lb/cu. ft. Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F minimum.
2. Fiber Color: Natural, except darkened where visible through joints in cladding.
3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Industry-wide EPD.

C. Attachment to Substrate, Masonry Veneers: Manufacturer's recommended mechanical attachment clip or disk.

D. Attachment to Substrate, Panel Veneers: Manufacturer's recommended adhesively attached, spindle-type insulation anchors.

2.3 BLANKET INSULATION, MINERAL-WOOL BLANKET

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Owens Corning; Thermafiber UltraBatt FF.
2. Isolatek International.
3. Rockwool (formerly Roxul).

B. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Recycled Content: 70 percent min.
2. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
3. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification, formaldehyde-free.

C. Mineral-Wool Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene. GreenGuard certified as formaldehyde free and low chemical emissions.

2.4 SPRAYED-FOAM INSULATION, AT GAPS AND VOIDS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Dow Chemical; GreatStuff Pro.
2. ICP Adhesives and Sealants (formerly Fomo Products): Handi-Foam products.
3. Approved equal.

B. Sprayed-Foam Insulation: Water-cure closed cell polyurethane containing no urea-formaldehyde and no CFCs.

1. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 4.0 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Fire Resistance: UL 723, Flame Spread 25 max., and Smoke Developed 50 max.
3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Industry-wide EPD.
4. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2.5 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

1. Low-Emitting Materials: Provide interior adhesives in compliance with the 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. Do not use adhesives that contain urea formaldehyde.
3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

B. Masonry and Concrete Fasteners:

1. Hardened nails, pneumatically-driven fasteners or other anchors recommended by insulation manufacturer, sufficient to penetrate substrate and permanently retain insulation.
2. Self-adhering insulation stick pins: Galvanized steel plate welded to projecting steel spindle; capable of holding insulation thicknesses indicated securely in position indicated with self-locking galvanized steel washer in place. Backseal fastener penetrations.

C. Tape: Adhesive tape recommended by insulation manufacturer, to tape joints and tears in faced insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Miscellaneous Voids: Install spray polyurethane foam insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.

1. Cure insulation with continuous natural or mechanical ventilation.
2. Remove and dispose of over-spray.

3.4 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set rigid insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.

B. On horizontal surfaces, loosely lay rigid insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Install mineral wool board cavity insulation per manufacturer’s instructions. Fit insulation with edges butted tightly in both directions. Do not compress insulation. Maintain cavity width of dimension indicated between insulation and cladding material.

1. Masonry Veneers: Secure with clips installed over masonry anchors. Provide at least 6 clips per mineral wool board.
2. Panel Veneers: Secure with adhesively attached, spindle-type insulation anchors. Space anchors according to insulation manufacturer's written instructions.

3.6 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports.

B. Infrared Camera Survey: Perform an infrared camera scan of walls, floors, and ceilings to determine where insulation and air barrier are not continuous, after insulation has been installed, but prior to plaster patching or new gypsum board installation.

1. Provide complete digital report with images of test results with recommendations for repairs.

C. Repair or replace work where test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 072700

AIR BARRIERS

(Part of Work of Section 070001 - Waterproofing, Dampproofing and Caulking,
Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 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. Self-adhering, vapor-retarding, modified bituminous sheet air barrier.
2. Transition strips to adjacent and penetrating materials.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042000 - UNIT MASONRY for substrate for air and vapor barrier system.
2. Section 061600 - SHEATHING for sheathing substrate for air and vapor barrier system.
3. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for roof air and vapor barrier.
4. Section 079200 - JOINT SEALANTS for joint sealant requirements.

1.3 DEFINITIONS

A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall or soffit, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air Barrier Assembly Air Leakage: Not to exceed 0.03 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., ASTM E 2357.

1.5 PRECONSTRUCTION TESTING

A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. The Owner may engage a qualified testing agency.
2. Quantitative Air Leakage Testing: Testing of the mockup for air leakage will be conducted not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage when tested according to ASTM E 783.
3. Notify Architect and the Owner a minimum of seven days in advance of the dates and times when mockup testing will take place.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. 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 air barrier.
2. Include details of mockups.

C. 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 air barrier; signed by product manufacturer.

D. Qualification Data: For Applicator.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.7 QUALITY ASSURANCE

A. 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.

B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly 150 sq. ft., 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. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
3. If the Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.

1. Include installers of other construction connecting to air barrier, such as roofing, waterproofing, architectural precast concrete, masonry, joint sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.9 PROJECT 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 damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SELF-ADHERING SHEET MEMBRANE AIR BARRIERS

A. Self-Adhering, Vapor-Retarding Modified Bituminous Sheet: Rubberized asphalt laminated to cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing; CCW-705.
b. GCP Applied Technologies (formerly W.R. Grace); Perm-A-Barrier.
c. Henry Co.; Blueskin SA.
d. Rubber Polymer Corporation; Rub-R-Wall SA.
e. Tremco, Inc.; ExoAir 110.
f. W.R. Meadows; SealTight Air-Shield.

2. Thickness: 40 mils minimum.
3. Physical and Performance Properties:

a. Membrane Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Tensile Strength: 250 psi minimum; ASTM D 412, Die C, modified.
c. Ultimate Elongation: 200 percent minimum; ASTM D 412, Die C, modified.
d. Low-Temperature Flexibility: Pass at minus 20 deg F, ASTM D 1970.
e. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
f. Puncture Resistance: 40 lbf minimum; ASTM E 154.
g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
h. Vapor Permeance: 0.05 perms, ASTM E 96, Water Method.

4. Building Product Disclosure and Optimization, Material Ingredients: Declare product label.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous 40-mil-thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil-thick, crosslaminated polyethylene film with release liner backing.

D. Butyl Strip at Termination with EPDM or TPO Roofing Membrane: Vapor-retarding, 30- to 40-mil-thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.

E. Modified Bituminous Strip To Cover Cracks and Joints and Terminate Air Barrier to Compatible Roofing Membrane: Vapor-retarding, 40-mil-thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- polyethylene film with release liner backing.

F. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

J. Sprayed Polyurethane Foam Sealant to Fill Gaps at Penetrations and Openings: one- or two-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

K. Modified Bituminous Transition Strip to Seal Air Barrier Terminations with Glazing Systems: Vapor-retarding, 40-mil-thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene or aluminum film with release liner backing.

L. Preformed Silicone-Sealant Extrusion to Seal Air Barrier Terminations with Glazing Systems: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 123 Silicone Seal.
b. Elbex Corp: Transition Silicone Sheeting HS222.
c. GE Silicone; UltraSpan US1100.
d. Tremco; approved equal.

M. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 - JOINT SEALANTS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

G. Bridge and cover isolation joints expansion joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping modified bituminous strips.

H. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install butyl or modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing 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 strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, modified bituminous strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 INSTALLATION OF SELF-ADHERING SHEET MEMBRANE

A. Install modified bituminous sheets according to air barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air barrier sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply and firmly adhere modified bituminous sheets horizontally or vertically over area to receive air barrier sheets. Accurately align sheets and maintain a uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
2. Roll sheets firmly to enhance adhesion to substrate.
3. Apply termination mastic on any horizontal, field-cut or non-factory edges.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. Seal top of non-metallic through-wall flashings to air barrier sheet with an additional 6-inch- wide strip.

H. Seal exposed edges of metallic sheets at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Install air barrier sheets and auxiliary materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install compatible strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

J. 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.

K. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply membrane specified below so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.

L. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

M. At end or each working day, seal top edge of membrane to substrate with termination mastic.

N. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air barrier sheet extending 6 inches beyond repaired areas in all directions.

P. Do not cover air barrier until it has been tested and inspected by Owner’s testing agency.

Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will 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 the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has 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:

1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186.
2. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E 783.

D. Remove and replace deficient air barrier components and retest as specified above.

3.6 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed to these conditions for more than 30 days.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 072800

LIQUID-APPLIED INSULATIVE COATING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Spray-applied insulative coating including primer, insulative coating and topcoat. Applied to steel penetrating the exterior envelope, as indicated on the Drawings, and at a minimum 24 inches inboard and 24 inches outboard of the exterior envelope, including canopies, terraces and roof penetrations for dunnage and davits and similar items.
2. Aerogel filled thermal break tape including primer coating at locations where spray or roller applied coating is not practical (Contractor's option).
3. Apply at all thermal envelope penetration conditions, including slabs, vertical and horizontal structural penetrations, maintenance anchors, and crossbeams in accordance with Manufacturer’s requirements and details indicated on Drawings.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 051200 - STRUCTURAL STEEL FRAMING for steel substrates.
2. Section 055000 - METAL FABRICATION for steel substrates.
3. Section 078100 - APPLIED FIREPROOFING for fireproofing used in conjunction with liquid insulative coating.
4. Section 099000 - PAINTING AND COATING.

1.3 SUBMITTALS

A. Product Data: Submit product data including manufacturers technical data indicating product performance characteristics, performance and limitation criteria.

1. Confirm compatibility with proposed applied fireproofing.

B. Shop Drawings: Submit shop drawings with plans, elevations, and details showing all locations where this system will be applied.

1. Include details of interfaces with other materials that form part of air barrier.
2. Include details of mockups.
3. Include relationship with adjacent materials (roof membrane, air barrier flashing membranes, and similar items), indication of sequence of installation for coordination during construction, and materials and methods for sealing connections and penetrations.

C. Manufacturer's Instructions: Submit manufacturer written installation instructions.

D. Applicator Qualifications: Submit applicators current certification as a manufacturer trained applicator.

E. Performance Documentation: Submit published design listings for insulation value ratings and product thickness. Include evidence that the liquid thermal break testing was sponsored by the manufacturer and that the material tested was produced at the manufacturers facility under the supervision of technical personnel.

1.4 QUALITY ASSURANCE

A. Manufacturer:

1. Company specializing in manufacturing product in this section with a minimum of 2 years documented experience in manufacturing insulative technology.
2. Applicator: Company specializing in applying the work of this section with documented experience and certified / trained by the manufacturer.
3. Liquid applied thermal break acrylic system shall be the complete system from a sole source consisting of primer, acrylic thermal break material and topcoat.

B. Mock-up:

1. Minimum thirty days prior to application in any area, provide mock-up samples of coating materials in accordance with the following requirements:

a. Provide minimum two square feet on all representative substrates and conditions, where directed by the Engineer, for each different desired R Values and finish of required for the work.
b. Provide mock-up areas that comply with thickness, density application, finish texture, and color.
c. Inspect mock-up areas within one hour of application for variance due to shrinkage, temperature, and humidity.
d. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary to meet required installation, R Value, finish, and color requirements.
e. Continue to provide mock-up areas at the Contractor's expense until acceptable areas are produced.
f. Acceptable areas shall constitute standard of acceptance for method of application, thickness, finish texture, and color requirements, for Liquid applied thermal break material applications.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials in manufacturers' original, sealed, undamaged container with identification label intact. Packaged materials shall bear the appropriate labels, seals.

B. Storage: Materials shall be stored in strict accordance with manufacturers documented instructions.

C. Documentation: All batch number, product identification and quantities shall be recorded on appropriate QC documents. A copy of the transport document and manufacturers conformance certificate shall be attached to the material delivery on site.

1.6 PROJECT/SITE CONDITIONS

A. Project Environmental Requirements: Substrate and air temperature shall be in accordance with the manufacturers' requirements including the following:

1. Protect work area from windblown dust and rain. Protect adjacent areas from over spray of material.
2. Provide ventilation in areas to receive work of this section during application and minimum 24 hours after application.

B. Temperature and Humidity Requirements: Maintain air temperature and relative humidity in areas where products will be applied for a time period before during and after application as recommended by manufacturer.

1. Do not apply coatings when temperature of substrate and/or surrounding ambient air temperature is below 45 degrees F. Temporary protection and heat shall be maintained at this minimum temperature for 24 hours before, during and 24 hours after material application.
2. Steel substrate temperature shall be a minimum of 5 degrees F (3 degrees C) above the dew point of the surrounding air for a period of 24 hours prior and during the application of the material.
3. If necessary for job schedule, the General Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.
4. The relative humidity of the application area shall not exceed a maximum of 85 percent 24 hours prior, during and 24 hours after the application of the material. The relative humidity shall not exceed 75 percent throughout the application and drying of the decorative top coat finish.

1.7 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard 5-year material warranty.

PART 2 - PRODUCTS

2.1 LIQUID-APPLIED INSULATIVE COATING

A. Basis-of-Design: Tnemec Aerolon Series 971 Coating System by Tnemec, Kansas City, MO, as represented by The Righter Group, ww.rightergroup.com, Tel. 800-533-3003.

1. Steel: Surface Preparation and Primer for Coating Steel, Shop or Site Applied:

a. Preparation: Abrasive blast clean, SSPC SP-6 surface profile 2-3 mils. Remove weld splatter and grind defects smooth. Steel substrate temperature shall be a minimum of 5 degrees F above the dew point of the surrounding air for a period of 24 hours prior and during the application of the material.
b. Primer: Tnemec Series 1224T with less than 11 grams VOC, surface tolerant inorganic epoxy coating, at 6-8 mils DFT.

2. Galvanized Steel: Surface Preparation and Primer for Coating Steel, Shop or Site Applied:

a. Preparation: SSPC SP16.
b. Primer: Tnemec 135 Chembuild at 5-7 mils DFT.

3. Concrete: Surface Preparation and Primer for Coating Concrete, Site Applied:

    a. Preparation: Grind all surfaces smooth.
    b. Primer: Tnemec Series 1224T with less than 11 grams VOC, surface tolerant inorganic epoxy coating, at 6-8 mils.

4. Aluminum: Surface Preparation and Primer for Coating Aluminum, Site Applied:

    a. Preparation: Clean surface of foreign material, grind defects smooth.
    b. Primer: Tnemec Series 1224T with less than 11 grams VOC, surface tolerant inorganic epoxy coating, at 6-8 mils.

5. Insulative Coating: Coating Tnemec Series 971 Aerolon liquid-applied thermal break coating.

    a. Solids by Volume: 76 percent.
    b. Coating Type: Water based thermal acrylic, spray applied.
    c. Fire Performance: ASTM E 84, Class A.
    d. VOC Content: 0.01 lbs./Gallon (1.0 grams /liter).
    e. Thinned: 0.01 lbs./ gallon (1.0 grams /liter).
    f. HAPS: 0 lbs. per gallon solids.
    g. Curing Time: 75 degrees F, 4 hours to touch 16 hours to recoat.
    h. Thermal Transmission: ASTM C 518, no more than 50 mW/ mK.
    i. Net Weight per Gallon: 4.66 lbs. per gallon
    j. Storage Temperature: 40-110 degrees F.
    k. Number of Components: One component part powder not liquid
    l. Pot Life: 2 hours.
    m. Spray Life: 2 hours.
    n. Prohesion: ASTM D 5894, 4,00 hours.
    o. Salt Fog: ASTM B 117m 4,000 hours.
    p. Immersion: ASTM D 870 – 4,000 hours.
    q. Humidity: ASTM D 4585 – 4,000 hours
    r. Water Immersion: ASTM D 870 Method B, 2,000 hours at 140 degrees.
    s. Taber Abrasion Resistance: ASTM D 4060 (CS-17 Wheel, 1,000g load), no more than 50 mg loss after 1,000 cycles.
    t. Required Thermal Resistance, W Sections, 60 mils (approx 1/8 inch): 0.25 R-value.
    u. Required Thermal Resistance, HSS Sections, 120 mils (approx 1/16 inch): 0.50 R-value.

6. Topcoat: Tnemec Series 1028 Enduratone or Tnemec at 2-3 mils DFT for non-immersion services. Apply Tnemec Series 22 at 16-40 miles DFT depending on application for areas where immersion is required.

    a. Color for Exposed Applications: As selected by Architect.

2.2 AEROGEL FILLED THERMAL BREAK TAPE

A. Basis-of-Design: Tnemec Aerolon Series 945 Peel & Stick by Tnemec, Kansas City, as represented by The Righter Group, ww.rightergroup.com, Tel. 800-533-3003.

1. Primer Coating For Steel or Concrete to Receive Thermal Break Tape: Tnemec Series 90-97, 394, 530V (Concrete) or 1224 VOC, surface tolerant inorganic epoxy conforming to the following requirements. Galvanized metal must be clean dry and abraded.

a. Bond Strength: ASTM D4541 1320 psi
b. Abrasion Resistance: ASTM 4060 181 mg
c. Cathodic Disbondment: ASTM D G8- No disbondment 3000 Hrs.
d. Water Vapor Transmission: ASTM D 1653 4.68 g/m2 /24hrs/<0.22 prms.

2. Tnemec Series 945 Aerogel Filled thermal break tape, 76% solids, conforming to the following requirements: Material may be shop or field applied.

a. Solids by Volume: 76% Water based thermal insulative acrylic tape.
b. Recommended Film Thickness: 60 mil thick Aerolon Tape applied in multiple applications to specified R Value.
c. VOC Content: 0.01 lbs./Gallon (1.0 grams /liter).
d. Thinned: 0.01 lbs./ gallon (1.0 grams /liter).
e. HAPS: 0 lbs. per gallon solids.
f. Curing Time at 75 degrees F: 4 hours to touch , 16 hours to recoat.
g. Thermal Transmission: Must meet ASTM C 518 - No more than 49.8mW/ mK.
h. Net Weight per Gallon: 4.66 lbs. per gallon.
i. Storage Temperature 40 degrees F Maximum 110 degrees F
j. Number of Components: ne component.
k. Primer Required: As recommended by manufacturer.
l. Topcoat Required: Refer to Section 2.0 and 3.0.
m. Pot Life: 2 hours.
n. Spray Life: 2 hours.

3. Thermal Resistance of Thermal Break Tape: Thermal Conductivity (ASTM C518 at 77°F): 0.0497 W/m-°K or 0.3446 BTU-in/ft²-hr-°F (R value at one inch equals 2.9) Tnemec 945 is to be applied in 60 mil (1.5mm) lifts to desired R value established by Architect. Performance Data:

a. ASTM E 84 – Class A.
b. ASTM D 5894 – 4,000 hrs Prohesion.
c. ASTM B 117 – 4,000 hrs Salt Fog.
d. ASTM D 870 – 4,000 hrs. Immersion.
e. ASTM D 4585 – 4,000 hrs. Humidity.
f. 18 Months Roof Exposure.
g. Compatible with DOW 790 Sealant.

4. Application Thickness:

a. W Sections: One 60 mils layer.
b. HSS Sections: Two 60 mils layers.
c. Concrete: Minimum two 60 mil layers; confirm with manufacturer based on site conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Application shall not commence until the Contractor, Installer and Architect/Engineer have examined the surfaces to receive the primer and determined the surfaces are acceptable to receive the coatings and that the interface to adjacent air barrier materials has been reviewed and approved by all manufacturers. Commencement of application means acceptance of substrate.

B. Verify that substrate and workspace temperature and humidity conditions are in accordance with manufacturers recommendations.

3.2 PREPARATION

A. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be coated.

B. Clean, dry and free of oil, grease, loose mill scale, dirt, dust or other foreign substances which would impair bond of the material to the substrate.

C. Primer shall not be applied to prepared substrate until the area has been adequately vented to remove all airborne dust. Prior to the application of any coating material, the blast products, dust and debris, shall be removed by vacuuming.

3.3 APPLICATION OF INSULATIVE COATING

A. Equipment and application procedures shall conform to the manufacturer's application instructions. Materials shall be applied at the required dry film thickness per the appropriate thicknesses specified.

B. Apply primer at thickness recommended by manufacturer. Apply insulative coating 60 mils for W Shapes, 120 mils for HSS sections per wet film thickness (DFT) per lift. Measure final DFT with a dry film thickness gauge. Apply topcoat at thickness recommended by the manufacturer.

C. Follow all manufacturer recommendations regarding adhesion and compatibility requirements for materials that come in contact with the liquid-applied insulative coating.

D. Do not apply coatings to steel deck unless otherwise indicated.

E. Follow all manufacturer recommendations regarding adhesion and compatibility requirements for materials that come in contact with the liquid-applied insulative coating.

3.4 APPLICATION OF THERMAL BREAK TAPE

A. Equipment and application procedures shall conform to the manufacturer's application instructions. When the use of Tnemec Series 971 or 961 Aerolon Acrylic are used in concert with Tnemec 945 , apply 945 First and spray 971 or 961 onto the Aerolon 945 Tape.

B. Apply Tnemec Series 945 Aerolon, Aerogel Filled Thermal Break Tape at thicknesses / layer noted above mils per layer. Subsequent layers may be applied immediately after each other, using heat gun to activate adhesive more quickly as required in low temperature applications until final DFT is achieved for required. Work bubbles out of film with wallpaper or other rollers making 945 intimately bonded to substrate with no air gaps.

3.5 FIELD QUALITY CONTROL

A. The Owner will engage an independent testing laboratory inspect and verify the application of material in accordance with the provisions Tnemec Company.

1. Material inspection and testing shall be performed 24 hours after completion of final application coat.
2. The results of the above tests shall be made available to all parties at the completion of each pre-designated area and approval.

3. In-place material not in compliance with desired R Values the specification requirements shall be corrected prior to final acceptance.

B. The dry film thickness (DFT) of the applied material shall be measured with a non¬destructive coating thickness gage after material has completely cured. All measurements shall be documented in writing and furnished to the Owner.

3.6 CLEAN UP AND REPAIR

A. Upon completion of installation, excess material, overspray and debris shall be cleared and removed from the job site. Remove overspray materials from surfaces not required to be thermally protected.

B. Patching and repair to material, due to damage by other trades, shall be performed under this Section and paid for by the trade responsible for the damage. Patching shall be performed by applicators certified by the manufacturer and applied in accordance with the manufacturer application instructions.

END OF SECTION

SECTION 073113

ASPHALT SHINGLES

(Part of Work of Section 070002 - Roofing and Flashing, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 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. Asphalt shingles.
2. Underlayment.
3. Snow guards.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood nailers and cants.
2. Section 066600 - FIBERGLASS SPECIALTIES for cupola.
3. Section 076200 - SHEET METAL FLASHING AND TRIM.
4. Section 077100 - ROOF SPECIALTIES for gutters.

1.3 DEFINITION

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For the following products, of sizes indicated, to verify color selected:

1. Asphalt Shingle: Full size.
2. Ridge and Hip Cap Shingles: Full size.
3. Ridge Vent: 12-inch-long Sample.
4. Exposed Valley Lining: 12 inches square.
5. Self-Adhering Underlayment: 12 inches square.
6. Snow Guard: Full size.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for asphalt shingles.

D. Maintenance Data: For each type of asphalt shingle to include in maintenance manuals.

E. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain ridge and hip cap shingles ridge vents from single source from single manufacturer.

B. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790, for application and roof slopes indicated.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for asphalt shingles including related roofing materials.

a. Size: 48 inches long by 48 inches wide.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with the Owner, Architect, Owner’s insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.

1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.

B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing to be performed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Manufacturing defects.
b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.

2. Material Warranty Period: 30 years from date of Substantial Completion, prorated, with first three years nonprorated.
3. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor five years from date of Substantial Completion.

B. Special Project Warranty: Roofing Installer's Warranty, signed by roofing Installer, covering Work of this Section, in which roofing Installer agrees to repair or replace components of roofing that fail in materials or workmanship within the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Environmental Product Declarations (EPD): Industry-wide EPDs for asphalt shingles are available from the Asphalt Roofing Manufacturers Association (ARMA).

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atlas Roofing Corporation.
2. CertainTeed Corporation.
3. GAF Materials Corporation.

4. IKO.
5. Owens Corning.

C. Basis of Design: GAF Materials Corporation; Slateline.

D. Laminated-Strip Asphalt Shingles: ASTM D 3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.

1. Algae Resistance: Granules treated to resist algae discoloration.
2. Color and Blends: As selected by Architect from manufacturer's full range.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil-thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing, Inc.
b. GCP Applied Technologies (formerly W.R. Grace).
c. Henry Company.

B. Felt: ASTM D 226, Type II, asphalt-saturated organic felts, nonperforated.

2.3 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent with nonwoven geotextile filter strips; for use under ridge shingles.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Air Vent, Inc.; a Gibraltar Industries company.
b. Cor-A-Vent, Inc.
c. GAF Materials Corporation.

2.4 SNOW GUARDS

A. Snow-Guard Pads: Fabricated aluminum units, designed to be installed without penetrating shingles, and complete with predrilled holes or hooks for anchoring.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
b. M. J. Mullane Company, Inc.
c. SnoGuard.
d. Snow Management Systems.

e. Zaleski Snow-Guards for Roofs, Inc.

2.5 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch-diameter, barbed shank, sharp-pointed, with a minimum 3/8-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.

2.6 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 - SHEET METAL FLASHING AND TRIM.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below, lapped in direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

1. Eaves: Extend from edges of eaves 36 inches beyond interior face of exterior wall.
2. Rakes: Extend from edges of rake 36 inches beyond interior face of exterior wall.

3. Valleys: Extend from lowest to highest point 18 inches on each side.
4. Hips: Extend 18 inches on each side.
5. Ridges: Extend 36 inches on each side without obstructing continuous ridge vent slot.
6. Sidewalls: Extend beyond sidewall 18 inches and return vertically against sidewall not less than 4 inches.
7. Dormers, Chimneys, Skylights, and Other Roof-Penetrating Elements: Extend beyond penetrating element 18 inches and return vertically against penetrating element not less than 4 inches.
8. Roof Slope Transitions: Extend 18 inches on each roof slope.

C. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with [felt underlayment] [roofing] nails.

1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction to shed water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.

3.3 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 - SHEET METAL FLASHING AND TRIM.

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

3.4 ASPHALT SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 3/4 inch over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Fasten asphalt shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.

E. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches beyond center of valley. Use one-piece shingle strips without joints in valley. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches short of valley centerline. Trim upper concealed corners of cut-back shingle strips.

1. Do not nail asphalt shingles within 6 inches of valley center.
2. Set trimmed, concealed-corner asphalt shingles in a 3-inch-wide bed of asphalt roofing cement.

F. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

G. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

H. Snow-Guard Pads: Install snow-guard pads at locations indicated according to manufacturer's written installation instructions.

END OF SECTION

SECTION 074610

FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Fiber-cement siding.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 054000 - COLD-FORMED METAL FRAMING for secondary support framing supporting fiber-cement wall panels.
2. Section 072100 - THERMAL INSULATION for insulation behind fiber-cement panels.
3. Section 076200 - SHEET METAL FLASHING AND TRIM for copings, flashings, and other sheet metal work not part of fiber-cement wall panel assemblies.
4. Section 077700 - WALL CLADDING SUPPORT SYSTEM.
5. Section 079200 - JOINT SEALANTS for field-applied sealants not otherwise specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fiber-cement wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Structural Performance: Provide fiber-cement wall panel assemblies capable of withstanding the effects of gravity loads and loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592 and ASTM E 330 as applicable.

1. Wind Loads: As required by Code.
2. Deflection Limits: Engineer fiber-cement wall panel assemblies to withstand test pressures with deflection no greater than 1/180 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span, at code required loading.

C. Thermal Movements for Fiber-Cement Wall Panels: Provide fiber-cement wall panel assemblies that allow for noiseless thermal movements resulting from the following range in ambient temperatures and that prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects:

1. Ambient Temperature Range: Minus 20 to plus 180 deg F.

D. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of fiber-cement wall panel and accessory.

E. Shop Drawings: Show fabrication and installation layouts of fiber-cement wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

F. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Fiber-Cement Siding: 12 inches long.
2. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of fiber-cement wall panels adjacent to joint sealants.

G. Qualifications: Qualifications of professional engineer and qualifications of installer as specified.

1.4 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of panels that are similar to those indicated for this Project in material, design, and extent.

C. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Installer's responsibilities include fabricating and installing fiber-cement wall panel assemblies and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

D. Fabricator Qualifications: Certified by fiber-cement wall panel manufacturer to fabricate and install manufacturer's wall panel system.

E. Source Limitations: Obtain each type of fiber-cement wall panel through one source from a single manufacturer.

F. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

G. Fire-Resistance Ratings: Where indicated, provide fiber-cement wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to fiber-cement wall panel assemblies including, but not limited to, the following:

1. Meet with The Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, fiber-cement wall panel Installer, fiber-cement wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects fiber-cement wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to fiber-cement wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special details, wall penetrations, openings, and condition of other construction that will affect fiber-cement wall panels.
6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
7. Review temporary protection requirements for fiber-cement wall panel assembly during and after installation.
8. Review fiber-cement wall panel observation and repair procedures after fiber-cement wall panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, fiber-cement wall panels, and other manufactured items so as not to be damaged or deformed. Package fiber-cement wall panels for protection during transportation and handling.

B. Unload, store, and erect fiber-cement wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Store fiber-cement wall panels vertically, covered with suitable weathertight and ventilated covering. Store fiber-cement wall panels to ensure dryness, with positive slope for drainage of water. Do not store fiber-cement wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of fiber-cement wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before fiber-cement wall panel fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating fiber-cement wall panels without field measurements, or allow for field trimming of panels. Coordinate wall construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.7 COORDINATION

A. Coordinate fiber-cement wall panel assemblies with rain drainage work, flashing, trim, and construction of girts, studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fiber-cement wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of fiber-cement, metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace fiber-cement wall panels that show evidence of deterioration of finishes within specified warranty period.

1. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING AND TRIM

A. General: Siding made from fiber-cement board that complies with ASTM C 1186, Type A, Grade II; is classified as noncombustible when tested according to ASTM E 136; and has a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cembrit.
b. Cemplank.
c. CertainTeed Corp.
d. GAF Materials Corporation.
e. James Hardie Building Products.
f. Nichiha Fiber Cement.

2. Basis of Design: James Hardie Building Products; Cedarmill Planks.
3. Profile: 5/16 inch thick by 5 inch exposure.
4. Factory Finish: Manufacturer's standard factory finish.
5. Color: To be selected by Architect from Manufacturer's full range.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories made from same material as adjacent siding unless otherwise indicated.

B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated on the Drawings.

1. Colors for Decorative Accessories: As selected by Architect from manufacturer's full range of industry colors.

C. Flashing: Provide stainless-steel flashing complying with Section 076200 - SHEET METAL FLASHING AND TRIM at window and door heads and where indicated.

2.3 FABRICATION

A. General: Fabricate and finish fiber-cement wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Sheet Metal Accessories: Fabricate trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in fiber-cement to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of panels exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by fiber-cement wall panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or fiber-cement wall panel manufacturer for application but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and trim and related accessories.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Coordinate location of furring strips with required fastening.

3.3 INSTALLATION, GENERAL

A. General: Comply with siding and trim manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.

B. Install fiber-cement siding and trim and related accessories.

1. Install fasteners no more than 24 inches o.c. horizontally and 2 inches from ends.
2. Install minimum of two fasteners at each bearing for PVC boards up to 6 in. wide, three fasteners for boards up to 10 in. wide.
3. Align fasteners to engage framing member behind sheathing.
4. Install siding for average 5 in. exposure, adjusting as required to align courses with window and door openings.
5. Install PVC trim with shiplap vertical joints bonded with manufacturer’s adhesive. Provide two fasteners at end of each board.

C. Seal all holes and cuts in fiber cement siding. Seal all abandoned holes in sheathing and siding.

D. Install joint sealants as specified in Section 079200 - JOINT SEALANTS and to produce a weathertight installation.

3.4 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete fiber-cement wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align fiber-cement siding within installed tolerance of 1/4 inch in 20 feet non-accumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING AND PROTECTION

A. Replace fiber-cement siding that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 075400

THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Mechanically fastened membrane-roofing system.
2. Cover board over insulation.
3. Roof insulation.
4. Vapor retarder.
5. Flashing for equipment mounted on roofing and roofing penetrations.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
2. Section 066600 - FIBERGLASS SPECIALTIES for coordination with cupola.
3. Section 076200 - SHEET METAL FLASHING AND TRIM for metal roof penetration flashings, flashings, and counterflashings.
4. Section 077100 - ROOF SPECIALTIES for roof edge drainage system.
5. Section 079200 - JOINT SEALANTS for sealants.
6. Division 22 - PLUMBING for roof drains.
7. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for roof curbs for HVAC equipment.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience. PVC membrane shall be separated by specified cover board from extruded polystyrene insulation.

C. Roofing System Design: Roofing system shall be designed to withstand loads indicated on Drawings, but not less than loads required by Code.

D. Flashings: Provide base flashings, perimeter flashings, detail flashings and component materials that comply with requirements and recommendations in FMG 1-49 Loss Prevention Data Sheet for Perimeter Flashings; FMG 1-29 Loss Prevention Data Sheet for Above Deck Roof Components; NRCA Roofing and Waterproofing Manual (Fourth Edition) for Construction Details and SMACNA Architectural Sheet Metal Manual (Fifth Edition) for Construction Details, as applicable.

E. Energy Performance: Provide roofing system with Solar Reflectance Index (SRI) not less than the following when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency:

1. Low-sloped roof (less than or equal 2:12) - 82 minimum (initial): 64 (3-year aged).
2. Steep-sloped roof (greater than 2:12) - 39 minimum (initial); 32 (3-year aged).

F. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

G. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each roofing system and level. Include plans, elevations, sections, details, and attachments to other Work. Include manufacturer’s reviewed and approved details that are project-specific and include dimensions, scaled layouts, assembly profiles, and similar items. Manufacturer generic details will not be accepted. At a minimum, include the following:

1. Base flashings and membrane terminations.
2. Transitions to air barrier membrane.
3. Tapered insulation, including slopes.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations and note zone dimensions on shop drawing plans.
5. Requirments for meeting specified uplift requirements.
6. Tapered insulation layout, including amount and direction of slopes and drain sumps.
7. Walkway pad plan and detail, as required.
8. Proposed temporary, watertight, tie-off details for each substrate type.

C. Qualification Data: From Installer and manufacturer stating that the roof installer is acceptable to the manufacturer to install the specified system.

D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

E. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

F. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

G. Maintenance Data: For roofing system to include in maintenance manuals.

H. Sample Warranties: For manufacturer's special warranties.

I. Closeout Submittals: Following completion of Work, submit roofing system manufacturer's inspection report of completed roofing installation and completed warranty; submit Installer's completed warranty.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

B. Manufacturer Qualifications: A qualified manufacturer shall have minimum of ten years of experience in manufacturing of specified membrane.

C. Installer Qualifications: A qualified firm with at least five years project experience and at least three projects with size and complexity similar to the Project, that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

D. Roofing Inspector: Owner may engage a full-time roofing inspector during installation of the deck, insulation assembly, membrane, flashing and other appurtenances, and when a survey of the roof and roof drains is conducted. Cooperate with Owner's roofing inspector and allow unlimited access to roofing during construction.

E. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with the Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Roofing Contractor’s Warranty: The roofing subcontractor shall supply Owner with a minimum two-year workmanship warranty for each roof. In the event any work related to the roofing, flashing, or metalwork is found to be defective within two years of substantial completion, the roofing contractor shall remove and replace such at no additional cost to the Owner. The roofing subcontractor’s warranty obligation shall run directly to the Owner, and a copy the roofing signed warranty shall be sent to the roofing system’s manufacturer.

1. The duration of the Roofing Contractor’s two-year warranty shall run concurrent with the roofing system’s manufacturer’s 20-year warranty.

B. Roofing Systems Manufacturer’s Warranty: The roofing manufacturer shall guarantee roof areas to be in a watertight condition, for a period of 20 years, from the date of final acceptance of the roofing system. The warranty shall be a 20-year no dollar limit (NDL), non-prorated total system labor and material warranty, for wind speed as required by Code or as indicated on the Drawings. Total system warranty shall include all roofing materials, related components and accessories including, but not limited to the substrate board, vapor retarder, insulation board, cover board, roofing membrane, membrane flashings, fasteners, adhesives, metal roof copings, metal roof edges and termination metals and roof drain assemblies. The manufacturer shall repair defects in materials and workmanship as promptly after observation as weather and site conditions permit.

PART 2 - PRODUCTS

2.1 PVC ROOFING MEMBRANE

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carlisle SynTec Systems; Sure-Flex PVC.
2. Duro-Last Roofing, Inc.
3. Flex Roofing Systems

4. GAF Materials Corporation.
5. Johns Manville.
6. Sika Sarnafil Inc.
7. Versico Roofing Systems; Versiflex PVC Membrane.

B. PVC Sheet: ASTM D 4434, Type III, fabric reinforced.

1. Thickness: 60 mils (1.5 mm), nominal.
2. Exposed Face Color: White.
3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Single-Ply Roof Membrane Adhesives: 250 g/L.
f. Single-Ply Roof Membrane Sealants: 450 g/L.
g. Nonmembrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.
i. Sealant Primers for Porous Substrates: 775 g/L.
j. Other Adhesives and Sealants: 250 g/L.

3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.

C. Bonding Adhesive: Manufacturer's recommended bonding adhesive.

D. Metal Termination Bars: Manufacturer's standard predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

E. Expansion Joint: Watertight, high-movement, weldable roof expansion joint.

1. Basis of Design: Emseal; RoofJoint or approved equal by roofing manufacturer.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.3 VAPOR RETARDER

A. Self-Adhering Sheet Vapor Retarder: ASTM D 1970, minimum 40-mil- thick film laminated to layer of rubberized asphalt adhesive; maximum permeance rating of 0.1 perm; cold-applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.4 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Roofing Corporation.
b. Carlisle SynTec Incorporated.
c. Firestone Building Products Company.
d. GAF Materials Corp.
e. GenFlex Roofing Systems.
f. Johns Manville International Inc.

2. Compressive Strength at Terraces: In accordance with ASCE 7-05, “Minimum Design Load for Building and other Structures”, pedestrian terraces are required to support a minimum live load of 100 psf. Use 40 psi insulation for when pavers are on pedestals and exclusive of planters and other heavy concentrated loads such as heavy wheel traffic.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Cover Board: Provide the following, as required by roofing manufacturer to comply with performance requirements and provide specified warranty.

1. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 or 5/8 inch thick, factory primed.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured vinyl walkway pads or rolls approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck comply with requirements in Section 053100 - STEEL DECKING.
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
7. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 VAPOR-RETARDER INSTALLATION

A. Self-Adhering Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering sheet vapor retarder over area to receive vapor retarder, side, and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.

B. Completely seal vapor retarder at side laps, end laps, terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.4 INSULATION AND COVERBOARD INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
2. For insulation applied in multiple layers, loose-lay first layer and mechanically fasten top layer.

H. Mechanically Fastened Cover Boards: Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and mechanically fasten to roof deck.

1. Mechanically fasten cover boards, unless otherwise indicated.
2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

3.5 MECHANICALLY FASTENED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

B. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

C. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.

D. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

G. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.

H. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement (except for heat-welded application), and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.

3.7 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Manufacturer’s Technical Representative: Engage a qualified manufacturer’s technical representative to perform roof tests and inspections and to prepare test reports.

C. Final Roof Inspection: Engage roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect and the Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect membrane-roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and the Owner.

B. Correct deficiencies in or remove membrane-roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane-roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 076200

SHEET METAL FLASHING AND TRIM

(Part of Work of Section 070002 - ROOFING AND FLASHING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Sheet metal flashing and trim for the following applications:

a. Through-wall flashing.
b. Formed wall flashing and trim.
c. Formed low-slope roof flashing and trim.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042000 - UNIT MASONRY for through-wall flashings in masonry.
2. Section 061000 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
3. Section 072700 - AIR BARRIERS for perimeter terminations at air and vapor barrier assembly.
4. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for installing sheet metal flashing and trim integral with roofing membrane.
5. Section 079200 - JOINT SEALANTS for field-applied sheet metal flashing and trim sealants.
6. Section 079500 - EXPANSION CONTROL for manufactured sheet metal expansion-joint covers.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Fabricate and install roof edge flashing and copings capable of resisting Wind Zone forces required by Code according to recommendations in FMG Loss Prevention Data Sheet 1-49.

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist

rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

E. Interface with Other Systems:

1. Do not proceed with installation of flashing and sheet metal until completion of curb and substrate construction, cants, blocking, reglets and other construction required to receive flashing.
2. Coordinate flashing with other Work for correct sequencing of items comprising entire membrane or system of roofing or waterproofing and rain drainage.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1. Meet with the Owner, Architect and Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005. Thickness as specified in this Section. Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, with No. 2D dull, cold-rolled finish. Thickness as specified in this Section.

2.2 UNDERLAYMENT MATERIALS

A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Isolation Coating: ASTM D 1187, cold-applied asphalt emulsion, VOC compliant, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength. Provide 2 in. min. end dams at terminations (riveted and sealed watertight).
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Soldered Seams in Stainless Steel: Prefabricated inside and outside corners and 2 in. min. end dams at terminations (riveted and soldered watertight).

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Caps: Fabricate in minimum 96-inch-long, but not exceeding 10-foot- long, sections. Furnish with 6-inch-wide joint cover plates.

1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
2. Fabricate from the following material:

a. Aluminum: 0.050 inch (1.27 mm) thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
2. Fabricate copings from the following material:

a. Aluminum: 0.050 inch (1.27 mm) thick.

C. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following material:

1. Stainless Steel: 0.025 inch (0.64 mm) thick.

D. Base Flashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

E. Counterflashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

F. Roof-Penetration Flashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

G. Roof-Drain Flashing: Fabricate from the following material:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

H. Splash Pans: Fabricate from the following material:

1. Stainless Steel: 0.025 inch thick.

2.6 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing, Typical: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch-high end dams. Fabricate from the following material:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Through-Wall Flashing, in Masonry: Through-wall flashing in masonry is specified in Section 042000 – UNIT MASONRY.

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system. Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer installation instructions, and SMACNA “Architectural Sheet Metal Manual”. Anchor units work of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal

fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints and seams that will be permanently watertight and weatherproof.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of stainless-steel sheet metal flashing and trim with isolation coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip-sheet or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

1. Aluminum: Use aluminum or stainless steel fasteners.
2. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 - JOINT SEALANTS.

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.

1. Do not solder aluminum sheet.
2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions,] and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing in Masonry: Installation of through-wall flashing in masonry is specified in Section 042000 - UNIT MASONRY.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 077100

ROOF SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Roof-edge drainage systems.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
2. Section 062000 - EXTERIOR FINISH CARPENTRY for wood gutters.
3. Section 066600 - FIBERGLASS SPECIALTIES for cupola.
4. Section 079200 - JOINT SEALANTS for sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work. Include the following:

1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.

2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.
3. Details of termination points and assemblies, including fixed points.
4. Details of special conditions.

C. Samples for Verification: For roof-edge drainage systems made from 12-inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including gutter and downspout approximately 10 feet long, including supporting construction, seams, attachments, and accessories.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

B. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

PART 2 - PRODUCTS

2.1 EXPOSED METALS

A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005. Thickness as specified in this Section. Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Fluoropolymer 3-Coat System: Manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat

containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

1) Color: As selected by Architect from manufacturer's full range.

2.2 CONCEALED METALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
3. Fasteners for Zinc-Coated Copper Sheet: Series 300 stainless steel.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ATAS International, Inc.
2. Berger Building Products, Inc.
3. Cheney Flashing Company.
4. Hickman Company, W. P.
5. Merchant & Evans, Inc.
6. Metal-Era, Inc.
7. Metal-Fab Manufacturing, LLC.
8. MM Systems Corporation.

B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Fabricate from the following exposed metal:

a. Aluminum: 0.050 inch (1.27 mm) thick.

2. Gutter Profile: As indicated according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and soldered.
4. Gutter Supports: As indicated with finish matching the gutters.
5. Leaf Guard: Powder coated, expanded galvanized steel.

a. Basis of Design: Leaf Filter; Gutter Guard.

6. Gutter Accessories: Bronze wire ball downspout straine.

C. Downspouts: Plain round complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Aluminum: 0.040 inch (1.02 mm) thick.

D. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout.

1. Fabricate from the following exposed metal:

a. Aluminum: 0.040 inch (1.02 mm) thick.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.

3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise shown on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and solder to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

1. Provide elbows at base of downspout to direct water away from building.

D. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch below gutter discharge.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 077200

ROOF ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Roof hatches and safety rails.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS for metal vertical ladders, ships' ladders, and stairs for access to roof hatches, and from roof to roof.
2. Section 061000 - ROUGH CARPENTRY for wood cants and wood nailers
3. Section 076200 - SHEET METAL FLASHING AND TRIM for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
4. Section 089000 - LOUVERS AND VENTS for elevator vents.
5. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for roof-mounted ventilators.
6. Division 26 - ELECTRICAL for power supply and final connections for automatically operated heat and smoke vents.

1.3 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

1.4 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 ROOF HATCHES

A. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babcock-Davis; ThermalMAX roof hatch.
2. Bilco; Thermally Broken Roof Hatch.

B. Roof Hatches, Thermally Broken Types: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. external and 20-lbf/sq. ft. internal loads.
2. Type and Size: Lid type and size as indicated on Drawings.
3. Curb and Lid Material: Galvanized steel or aluminum sheet, 0.079 inch thick.
4. Insulation: Manufacturer's standard board insulation, R-18 min.
5. Curb: Fabricate units to minimum height of 12 inches.
6. Thermal Break: Fabricate with thermal break between interior and exterior surfaces.
7. Hardware: Galvanized steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
8. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.

C. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.

4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
9. Fabricate joints exposed to weather to be watertight.
10. Fasteners: Manufacturer's standard, finished to match railing system.
11. Finish: Manufacturer's standard.

2.2 MISCELLANEOUS MATERIALS

A. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

B. Isolation Coating: ASTM D 1187, cold-applied asphalt emulsion, VOC compliant, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

C. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

E. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
2. Verify dimensions of roof openings for roof accessories.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with isolation coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip-sheet, or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Roof Hatch Installation:

1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
2. Attach safety railing system to roof hatch curb.
3. Attach ladder safety post according to manufacturer's written instructions.

F. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

3.3 TOUCH UP

A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Section 099000 - PAINTING AND COATING.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 077700

WALL CLADDING SUPPORT SYSTEM

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Fiber cement siding support system, infilled with continuous insulation.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 054000 – COLD-FORMED METAL FRAMING for exterior wall framing.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design support system and framing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide support system and framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As required by code.

C. Structural: Provide system tested in accordance with ASTM E330 and certified to be without permanent deformation or failure of structural members in accordance with design wind velocities for project geographic location and probability of occurrence based on data from wind velocity maps such as provided in ASCE 7 and as approved by authorities having jurisdiction.

1. Measure performance using test loads equal to 1-1/2 times the design wind loads and with 10 second duration of maximum pressure.
2. Composite Framing Supports (CFS): Structurally engineered to provide in excess of 3 times structural safety factor for lengthwise, longitudinal, and crosswise loading.

D. System Thermal Design: Installed continuous insulation system including insulation, composite framing support, sub-girts, clips and cladding attachment shall not have thermal bridging of fasteners or framing that creates a continuous metal path from the exterior surface of the insulation to the stud framing inside the wall cavity or interior face of wall. System thermal design shall meet/exceed the thermal and design requirements per the Code.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.4 SUBMITTALS

A. Product Data: For each product.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For framing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Miscellaneous structural clips and accessories.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

F. Mock-Up: Provide labor and materials for mock-ups specified in Section 014000 – QUALITY REQUIREMENTS.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 COMPOSITE FRAMING SUPPORT

A. Composite Framing Support (CFS): CFS shall consist of polyester and vinyl ester bioresin matrix with recycled materials, ultra-violet inhibitor, fire retardant additives, and integral continuous metal inserts the length of profile. CFS shall be reinforced with glass strand rovings used internally for longitudinal (lengthwise) strength and continuous strand glass mats or stitched reinforcements used internally for transverse (crosswise) strength.

1. Basis of Design: Advanced Architectural Products (AAP); Simple Z-GreenGirt and other shapes as required by building configuration.
2. Height: As indicated on the Drawings.
3. On Center Spacing: 24 inches.
4. CFS Orientation: Vertical.
5. Provide continuous non-corrosive steel insert for engagement of fasteners, with G90 coating designation in compliance with ASTM A 653.

a. Steel insert shall fully engage with adjacent CFS at ends.
b. Sub-girts and other exterior wall panel support accessories shall be anchored to steel insert set into and part of the CFS.

6. Provide integral compression seal in CFS sections to ensure insulation panel will not dislodge and to stop air movement throughout system.
7. CFS section to have integral anti-siphon grooves on exterior flanges.
8. CFS section to have force distribution zones integrally designed into profile.
9. CFS to have spline seals for adjacent insulation units.
10. Surface Burning Characteristics:

a. Flame Spread: 25 or less, when tested in accordance with ASTM E 84.
b. Smoke Development: 450 or less, when tested in accordance with ASTM E 84.

11. Flammability: UL 94.

12. Self-Extinguishing: ASTM D 635.
13. Profile Visual Requirements: ASTM D 4385.
14. Tensile Stress: Engineered lengthwise and crosswise tensile stress is in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D 638.
15. Compressive Stress: Engineered lengthwise and crosswise compressive stress is in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D 695.
16. Flexural Stress: Engineered lengthwise and crosswise flexural stress is in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D 790.
17. Modulus of Elasticity: Engineered to meet the performance loading criteria and specified safety factors.
18. Barcol Hardness: 45, in accordance with ASTM D 2583.
19. Water Absorption: Less than 0.46 percent by weight, within 24 hours, in accordance with ASTM D 570.
20. Density: Within range of 0.062 to 0.070 lbs/cu in, in accordance with ASTM D 792.
21. Lengthwise Coefficient of Thermal Expansion: 7.0 x 10-6 inch/inch/degrees F, in accordance with ASTM D696.
22. Notched Izod Impact, Lengthwise: 24 ft lbs/in, in accordance with ASTM D 256 within temperature range indicated.
23. Notched Izod Impact, Crosswise: 4 ft lbs/in, in accordance with ASTM D 256 within temperature range indicated.

2.2 INSULATION

A. Refer to Section 072100 – THERMAL INSULATION.

2.3 SUB-GIRTS

A. Sub-Girts: Provide metallic coated steel with G90 (Z275) coating designation, ASTM A 653/653M; structural quality.

1. Basis of Design: Architectural Advanced Panels; AAP 625 or AAP 1000 Hat Girt Size: As indicated on the Drawings.
2. Gage: 16 gage.
3. On Center Spacing: As indicated on the Drawings.
4. Orientation: As indicated on the Drawings.

2.4 ASSEMBLY

A. Assemble continuous insulation wall panel support system using manufacturer’s standard procedures and processes identical to tested units and as necessary to comply with performance requirements indicated.

B. Comply with exterior wall panel profiles and with dimensional and structural requirements as indicated on the Drawings. Refer to Section 074610 – FIBER CEMENT SIDING.

C. Fabricate wall panel support system with joints between exterior wall panels designed to form weathertight seals. Refer to Section 074610 – FIBER CEMENT SIDING.

D. Form wall panel support system in a continuous process with no glues or adhesives between dissimilar materials.

E. The CFS and Insulation panels shall create a 3 in 1 Air/Water/Vapor class 1barrier system compliant with requirements for project geographic zone.

2.5 ACCESSORIES

A. Provide accessories necessary for a complete wall panel support system.

B. Fasteners: Corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by panel support system manufacturer for project application.

1. Cladding to CFS: Use standard Tek brand screws.
2. CFS to Stud Wall Framing: Use standard Tek® brand screws.
3. CFS to Concrete/CMU: Use Tapcon brand anchors.

C. Sealants: Provide sealants as recommended by exterior wall panel manufacturer for openings within wall panels and perimeter conditions.

1. Refer to Section 079200 – JOINT SEALANTS for requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas of this work, and project conditions with installer present for compliance with requirements for installation tolerances, substrates, wall panel support conditions, and other conditions affecting performance of this Work.

B. Examine structural wall framing to ensure that angles, channels, studs, and other structural support members have been installed within alignment tolerances required by continuous insulation wall panel support system manufacturer.

C. Verify that water resistive barrier has been installed over exterior sheathing to control air infiltration or water penetration as indicated for project.

D. Examine rough-in for components and systems penetrating wall panel support system to coordinate actual locations of penetrations relative to exterior wall panel joint locations prior to installation.

E. Verify that mechanical and electrical services for exterior walls have been installed and tested and, if appropriate, verify that adjacent materials and finishes are dry and ready to receive insulation.

F. Proceed with installation only after exterior walls have been properly prepared and unsatisfactory conditions have been corrected.

3.2 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. Prepare sub-girt, base angles, sills, furring, and other wall panel support members and provide anchorage in accordance with ASTM C 754 for gypsum panel type substrates and panel manufacturer's installation instructions.

3.3 INSTALLATION, GENERAL

A. Install wall panel support system in accordance with manufacturer's installation instructions.

B. Install system to fill-in exterior spaces without gaps or voids. Do not compress panel insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.

E. Exposed insulation must be protected from open flame and kept dry at all times.

F. Exterior wall insulation panels are not intended to be left exposed for periods of time in excess of 60 days without adequate protection.

1. When extended exposure is anticipated, protect exposed insulation surfaces including corners, window and door openings with a compatible waterproof tape.

G. Install wall panel support system in compliance with exterior wall panel orientation, sizes, and locations as indicated on Drawings.

3.4 TOLERANCES

A. Shim and align wall panel units with installed tolerances of 1/4 inch in 20 feet, non-cumulative, on level, plumb, and location lines as indicated.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Refer to Division 07 – THERMAL AND MOISTURE PROTECTION, exterior cladding sections for additional requirements.

3.6 PROTECTION

A. Protect installed products from damage until date of Substantial Completion.

B. Ensure that insulation panels are not exposed to moisture.

1. Remove wet insulation panels or allow them to completely dry prior to installation of exterior wall panel system.

C. Replace damaged insulation panels prior to date of Substantial Completion.

END OF SECTION

SECTION 078410

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Through-penetration firestopping systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
2. Installation Responsibility: Assign installation of through-penetration firestopping systems and fire-resistive joint systems in Project to a single qualified installer.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 078440 - FIRE-RESISTIVE JOINT SYSTEMS for joints in or between fire-resistance-rated construction, at exterior curtain wall/floor intersections, and in smoke barriers.
2. Section 079200 - JOINT SEALANTS for standard joint sealants.
3. Section 142100 - ELECTRIC TRACTION ELEVATORS for cutting penetrations for elevator piping, cabling and conduit.
4. Division 21 - FIRE SUPPRESSION for cutting penetrations for fire-protection piping.
5. Division 22 - PLUMBING for cutting penetrations for piping.
6. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for cutting penetrations for duct and piping.
7. Division 26 - ELECTRICAL for cutting penetrations for cable and conduit.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestopping systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Horizontal assemblies include floors, floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.
2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping:

1. Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
2. For through-penetration firestopping systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

    a. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestopping systems demonstrating no evidence of water leakage when tested according to UL 1479.
    b. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestopping systems capable of supporting floor loads involved, either by installing floor plates or by other means.

F. For penetrations involving insulated piping, provide through-penetration firestopping systems not requiring removal of insulation.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestopping system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestopping system configuration for construction and penetrating items.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestopping system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestopping systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain through-penetration firestopping systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

B. Installer Qualifications: Either a firm that has been approved by FMG according to FM Approval 4991, "Approval Standard for Firestop Contractors" or a firm experienced in installing through-penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction of a minimum of five projects with a record of successful performance.

1. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.

C. Fire-Test-Response Characteristics: Provide through-penetration firestopping systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestopping systems acceptable to authorities having jurisdiction.
2. Through-penetration firestopping systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

a. Through-penetration firestopping system products bear classification marking of qualified testing and inspecting agency.
b. Through-penetration firestopping systems correspond to those indicated by reference to through-penetration firestopping system designations listed in the UL “Fire Resistance Directory.”

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestopping system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestopping systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install firestopping systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure firestopping materials per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Jobsite conditions of each through-penetration firestopping system must meet all details of the UL-Classified System selected. If jobsite conditions do not match any UL-classified systems, contact firestop manufacturer for alternative systems or Engineer Judgment Drawings.

1. Verify that the schedule is current at the time of construction, and that each referenced system is suitable for the intended application.

B. Coordinate work with other trades to assure that penetration-opening sizes are appropriate for penetrant locations.

C. Coordinate construction of openings and penetrating items to ensure that through-penetration firestopping systems are installed according to specified requirements.

D. Coordinate sizing of sleeves, openings, core-drilled holes, and cut openings to accommodate through-penetration firestopping systems.

E. Do not cover up through-penetration firestopping system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products and firestopping systems that may be incorporated into the Work include, but are not limited to the following:

1. Hilti, Inc.
2. RectorSeal.
3. Specified Technologies, Inc. (STI).
4. Tremco.
5. 3M; Fire Protection Products Division.

2.2 FIRESTOPPING MATERIALS

A. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply 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."

B. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.
4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

C. Compatibility: Provide through-penetration firestopping systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestopping systems, under conditions of service and application, as demonstrated by through-penetration firestopping system manufacturer based on testing and field experience.

D. Materials: Provide through-penetration firestopping systems containing primary materials and fill materials which are part of the tested assemblies indicated in the approved Through-Penetration Firestop System Schedule submittal. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

1. Available Products: Subject to compliance with requirements, through-penetration firestopping products that may be incorporated into the Work include, but are not limited to the following:

a. BioFireshield; RectorSeal Smoke and Acoustic Sealant.
b. Hilti; CP 606 Flexible Firestop Sealant.
c. Hilti; CP 653 BA Firestop Speed Sleeve.
d. Hilti; FS-ONE MAX Intumescent Firestop Sealant.
e. STI; SpecSeal LCI Intumescent Firestop Sealant.
f. Tremco; TREMstop Acrylic.

2. Low-Emitting Materials: Certified Clean Air Gold or GreenGuard Gold certifications.

E. Accessories: Provide components for each through-penetration firestopping system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for firestopping systems indicated.

2.3 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestopping systems to comply with firestopping system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestopping systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestopping systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Taping: Use masking tape to prevent through-penetration firestopping systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping system materials. Remove tape as soon as possible without disturbing firestopping system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestopping systems to comply with Part 1 "Performance Requirements" Article and with firestopping system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for firestopping systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports, as required by 2015 IBC 1705.17 and 1705.17.1.

1. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports
2. Cooperate with field quality control personnel. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

B. Repair or replace work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Proceed with enclosing through-penetration firestopping systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean excess materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestopping systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 078440

FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the Work of this Section, including but not limited to fire-resistive joint systems for the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Wall-to-wall joints.
5. Perimeter fire-resistive joint systems consisting of floor-to-wall joints between perimeter edge of fire-resistance-rated floor assemblies and exterior curtain walls.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 078410 - PENETRATION FIRESTOPPING for firestopping.
2. Division 21 - FIRE SUPPRESSION for fire-protection piping penetrations.
3. Division 22 - PLUMBING for piping penetrations.
4. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for duct and piping penetrations.
5. Division 26 - ELECTRICAL for cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to

authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Fire-Resistive Joint Systems Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

D. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

E. Qualification Data: For Installer.

F. Field quality-control test reports.

G. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration fire stop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction of a minimum of five projects with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Evidence of FMG 4991 approval is acceptable for installer qualifications, but not mandatory.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:

a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, fire-resistive joint systems that may be incorporated into the Work include, but are not limited to the following:

1. Hilti, Inc.
2. Metacaulk; RectorSeal Corporation.
3. Specified Technologies, Inc. (STI).
4. 3M; Fire Protection Products Division.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Low-Emitting Materials: Fire-resistive joint system sealants shall comply 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."

B. VOC Content: Provide fire-resistive joint system sealants that comply with the following limits for VOC content:

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.
4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

C. General: Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

D. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079.

E. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa) or ASTM E 2307.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

F. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.

1. L-Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.

G. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

H. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports, as required by 2015 IBC 1705.17 and 1705.17.2. Independent inspecting agency shall comply with ASTM E 2393 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.

1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

SECTION 079200

JOINT SEALANTS

(Part of Work of Section 070001 - WATERPROOFING, DAMPPROOFING AND CAULKING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Joint sealants and fillers.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042000 - UNIT MASONRY for masonry control and expansion joint fillers and gaskets.
2. Section 088000 - GLAZING for glazing sealants.
3. Section 092110 - GYPSUM BOARD ASSEMBLIES for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Section 093000 - TILING for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
5. Section 095100 - ACOUSTICAL CEILINGS for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

D. Qualification Data: For Installer and qualified testing agency.

E. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

F. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

G. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

H. Field Test Report Log: For each elastomeric sealant application.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

D. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

a. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
b. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with joint sealant backing and glazing and gasket materials.

2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
3. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

4. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:

   a. Each type of elastomeric sealant and joint substrate indicated.
   b. Each type of nonelastomeric sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.

   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.

      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Low-Emitting Materials: Interior sealants shall comply 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."

C. VOC Content: Provide interior sealants and sealant primers that comply with the following limits for VOC content:

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.
4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

D. Colors of Exposed Joint Sealants: Provide colors as selected by the Architect from manufacturer’s full range of standard and custom colors; maximum of five colors, three standard colors and two custom colors.

2.2 JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates. Provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600 or ANSI/NSF Standard 51.

D. Exterior Silicone Sealant, Single-Component Neutral-Curing Type:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 790.
b. GE Silicones; SilPruf LM SCS2700.
c. Pecora Corporation; 864.
d. Tremco Inc.; Spectrem 1.

2. Extent of Use: Exterior joints in vertical and soffit surfaces.

E. Exterior Urethane Sealant, Multicomponent Pourable (Self-Leveling) Type for Pedestrian Traffic: ASTM C 920, Type M, Grade P, Class 25, Use T, M, & O.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Meadows, W. R., Inc.; POURTHANE.
b. Pecora Corporation; Urexpan NR-200.
c. Sika; Sikaflex-2c SL.
d. Tremco Inc.; THC-901.

2. Extent of Use: Exterior joints in horizontal surfaces.

F. Interior Sanitary Silicone Sealant, Single-Component Mildew-Resistant, Acid-Curing (Acetoxy) Type: ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, A, and O.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Bostik; Pure Silicone.
b. Dow Corning Corporation; 786 Mildew Resistant.
c. GE Silicones; Sanitary SCS1700.
d. Pecora; 898NST.
e. Sika; Sikasil GP.
f. Tremco; Tremsil 200.

2. Extent of Use: Interior sanitary joints at toilet rooms, kitchens, and other wet areas.

G. Interior Silicone Sealant for Movement Joints: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

H. Interior Acrylic Latex Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Henkel Corp.; Loctite Polyseamseal Acrylic Caulk with Silicone.
b. Pecora Corporation; AC-20+.
c. Tremco Inc.; Tremflex 834.

2. Extent of Use: Interior non-moving joints.

2.3 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin) or other type, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Availavle Products: Armacell Canada Inc.; ITP Standard Backer Rod; or approved equal.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry, unglazed surfaces of ceramic tile, and exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following metal, glass, porcelain enamel, and glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081110

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Standard hollow-metal steel doors and frames.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042000 - UNIT MASONRY for building anchors into masonry construction.
2. Section 087100 - DOOR HARDWARE for door hardware for steel doors.
3. Section 088000 - GLAZING for glazed lites.
4. Section 092110 - GYPSUM BOARD ASSEMBLIES for insulation.
5. Section 099000 - PAINTING AND COATING for field painting steel doors and frames.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, temperature-rise ratings, and finishes for each type of steel door and frame specified.

B. Shop Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Temperature-Rise Limit: Fire door assemblies in interior exit stairways and ramps and exit passageways shall have a maximum transmitted temperature rise of not more than 450 degrees F (250 degrees C) above ambient at the end of 30 minutes of standard fire test exposure. Exception: The maximum transmitted temperature rise is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with IBC Section 903.3.1.1 or 903.3.1.2.

D. Fire-Rated, Borrowed-Light Assemblies (Including Sidelights and Transoms): Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CURRIES Company; an ASSA ABLOY Group Company.
2. de LaFontaine
3. Philipp Manufacturing Company.
4. Steelcraft; an Allegion (formerly Ingersoll-Rand) company.

2.2 MATERIALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated, (Galvanized/Galvannealed) Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60/A60 metallic coating.

E. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

H. Insulation: Comply with requirements in Section 092110 - GYPSUM BOARD ASSEMBLIES.

I. Glazing: Comply with requirements in Section 088000 - GLAZING.

J. Environmental Product Declarations (EPD): Product-specific Type III EPDs for hollow metal doors and frames are available from manufacturers listed herein.

K. Low-Emitting Materials: Provide building products in compliance with the 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."

2.3 STANDARD STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.

a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
b. Thermal-Rated (Insulated) Exterior Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 2.5 when tested according to ASTM C 1363.

3. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick end closures or channels of same material as face sheets.
4. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated (galvanized/galvannealed) steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated (galvanized/galvannealed) steel sheet.

1. Fabricate frames with full profile welded joints.
2. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet.

1. Fabricate frames with full profile welded joints.
2. Frames for Level 2 Steel Doors: 0.053-inch-thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 LOUVERS

A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.

2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.

2.9 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.

2.10 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Full Profile Welded Frames: Weld joints continuously; grind, fill, dress, and make smooth, flush, and not visible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as doorframe. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Two anchors per jamb up to 60 inches high.
2) Three anchors per jamb from 60 to 90 inches high.
3) Four anchors per jamb from 90 to 120 inches high.
4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.

c. Compression Type: Not less than two anchors in each jamb.
d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 087100 - DOOR HARDWARE.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 - ELECTRICAL.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings, so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.11 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard epoxy primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
2. Refer to Section 099000 – PAINTING AND COATING for field-applied coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.

b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for filling space between frames and masonry with insulation.
5. Concrete Walls: Solidly fill space between frames and concrete with insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

   a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated (Galvanized/Galvannealed) Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 081400

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Solid-core flush wood doors for transparent and opaque finishes.
2. Factory finishing for wood doors with transparent finish.
3. Factory fitting flush wood doors to frames and factory machining for hardware.
4. Louvers and glass lites for flush wood doors.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 087100 - DOOR HARDWARE for hardware for wood doors.
2. Section 088000 - GLAZING for glass and glazing requirements.
3. Section 099000 - PAINTING AND COATING for field finishing of opaque wood doors.

1.3 SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core and edge construction, face type, louvers, and trim for openings.
2. Factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Requirements for veneer matching.
9. Doors to be factory primed or finished and application requirements.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of finish color, sheen, and grain to be expected in finished work.
2. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

D. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

F. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall include hardware installation and replacement of glass and glazing.
3. Warranty shall be in effect during the following period of time from date of Substantial Completion:

a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Lambton Doors; EnviroDesign Series.
2. Masonite Architectural; Aspiro and Graham Series (formerly Algoma and Marshfield). Cendura Series is not acceptable.
3. Oregon Doors; Architectural Series.
4. VT Industries Inc.; Eggers and Heritage collections.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish:

1. Grade: AWI Premium, with AWI Grade AA faces, 4 inch veneer width.
2. Species and Cut: To be selected by Architect.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces: Center-balance.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Transom Match: Continuous match.
7. Stiles: Same species as face.
8. Cross-Banding: 1/8 in. high density fiberboard, no added formaldehyde (NAF).
9. Adhesives: WDMA T.M.-6, Type I.

B. Doors for Opaque Finish:

1. Grade: Premium.
2. Faces for Interior Doors: Either medium-density overlay (MDO) or high-density fiberboard (HDF).
3. Stiles: Match face.
4. Cross-Banding: 1/8 in. high density fiberboard, no added formaldehyde (NAF).
5. Adhesives: WDMA T.M.-6, Type I.
6. Factory Primer: Manufacturer's standard water-based low VOC primer.

2.3 SOLID-CORE DOORS

A. Cores: Comply with the following requirements:

1. Composite Wood, General: CARB II compliant or made with binder containing no added formaldehyde (NAF).
2. Particle Core: ANSI A 208.1, Grade 1-LD-2.
3. Agrifiber Core: ANSI A 208.1, Grade 1-LD-2.
4. Structural Composite Lumber Core: WDMA I.S.10, Timberstrand LSL.
5. Provide doors with structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated or where light or louver cutouts exceed 40% of the door area.

B. Interior Veneer-Faced Doors:

1. Construction: Five plies, hot-pressed, with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.

    a. Fire Retardant Mineral Core, with no added formaldehyde cross-banding.

2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.

    a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

2.4 LOUVERS AND LIGHT FRAMES

A. Wood Louvers: Door manufacturer's standard solid-wood louvers, unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flat.

B. Fire Door Louvers (not required on 20 min. doors): Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire rating of one and one-half hours and less.

1. Metal and Finish: Galvanized steel, 0.0396 inch thick, hot-dip zinc coated and factory primed for paint finish.

C. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer's standard shape.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

D. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.

2.5 GLAZING SYSTEMS

A. Glazing: Provide factory installed glass products in accordance with requirements in Section 088000 - GLAZING.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA/DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining. Drill pilot holes for screws for butt hinges and lock fronts at the factory.
2. Metal Astragals: Factory prime and premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors to receive concealed vertical rod exit devices.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

1. Fabricate door and transom panels with full-width, solid-lumber meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal doorframes.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Louvers: Factory install louvers in prepared openings.

3. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 - GLAZING.

2.7 FACTORY FINISHING

A. Doors for Opaque Finish: Factory prime faces and edges of doors, including cutouts, with one coat of wood primer specified in Section 099000 - PAINTING AND COATING.

B. Doors for Transparent Finish: Factory finish doors that are indicated to receive transparent finish. Finish faces and edges of doors, including cutouts.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-8, UV cured acrylated polyester or urethane.
3. Staining: Provide water-based stain, custom color as selected by Architect.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 - DOOR HARDWARE.

B. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Protection: Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

C. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083110

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Access doors and frames for walls and ceilings.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 033000 - CAST-IN-PLACE CONCRETE for blocking out openings for access doors and frames in concrete.
2. Section 042000 - UNIT MASONRY for anchoring and grouting access door frames set in masonry construction.
3. Section 087100 - DOOR HARDWARE for rim cylinder locks and master keying.

1.3 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door and frame through one source from a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 for vertical access doors and frames.
2. ASTM E 119 for horizontal access doors and frames.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Steel Sheet: Electrolytic zinc-coated, ASTM A 879/A 879M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 STAINLESS-STEEL MATERIALS

A. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316. Remove tool and die marks and stretch lines or blend into finish.

1. Finish: Directional Satin Finish, No. 4.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acudor Products, Inc.
2. Babcock-Davis.
3. Dur-Red Products.
4. JL Industries (a division of Activar Construction Products Group).
5. Karp Associates, Inc.
6. Larsen's Manufacturing Company.
7. Milcor Inc.
8. Nystrom, Inc.

B. Flush Access Doors and Trimless Frames: Fabricated from steel sheet at typical areas and from stainless-steel sheet at toilet and wet areas.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.060-inch-thick sheet metal, set flush with surrounding finish surfaces.
3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead flange.
4. Hinges: Continuous piano.
5. Lock: Cylinder.

    a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100, DOOR HARDWARE.

C. Recessed Access Doors and Trimless Frames: Fabricated from steel sheet at typical areas and from stainless-steel sheet at toilet and wet areas.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.060-inch-thick sheet metal in the form of a pan recessed 5/8 inch for gypsum board infill.
3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead for gypsum board surfaces.
4. Hinges: Concealed pivoting rod hinge.
5. Lock: Cylinder.

    a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100, DOOR HARDWARE.

D. Fire Rated, Uninsulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from steel at typical areas and from stainless-steel sheet at toilets and wet areas.

1. Locations: Wall surfaces.
2. Fire-Resistance Rating: Not less than that of adjacent construction.
3. Door: Minimum 0.060-inch-thick sheet metal, flush construction.
4. Frame: Minimum 0.060-inch-thick sheet metal with 1-inch-wide, surface-mounted trim.
5. Hinges: Continuous piano.
6. Automatic Closer: Spring type.
7. Lock: Self-latching device with cylinder lock.

    a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100, DOOR HARDWARE

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. For trimless frames with drywall bead, provide edge trim for gypsum board and gypsum base securely attached to perimeter of frames.
2. For trimless frames with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
3. Provide mounting holes in frames for attachment of units to metal or wood framing.
4. Provide mounting holes in frame for attachment of masonry anchors.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder lock, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 083600

SIDE FOLDING DOORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Electrically-motor-operated side-folding insulated doors.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS for miscellaneous steel supports and framing.
2. Section 087100 - DOOR HARDWARE for lock cylinders and keying.
3. Section 061000 - ROUGH CARPENTRY for blocking and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

1. Wind Loads: As indicated on the Structural Drawings.

B. Operation-Cycle Requirements: Provide sectional overhead door components and operators capable of operating for not less than 10,000 cycles.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for folding doors.

B. Shop Drawings: For folding doors. Include plans, elevations, sections, details, attachments to other work, clearances required for operation, and accessory items. Show blocking.

C. Setting Drawings: For anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete and masonry, and for cutouts required in other work, including support-beam punching template.

D. Samples for Verification: For each type of folding door indicated and for each type of exposed finish required, in manufacturer's standard sizes.

E. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication

PART 2 - PRODUCTS

2.1 THERMALLY BROKEN ALUMINUM-FRAMED FOLDING GLASS WALL SYSTEMS

A. Basis-of-Design: Door Engineering and Manufacturing; Four-Fold FF300XT, Glazed.

B. Sections: Door framing shall be minimum 11-gauge structural steel tube with 14-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

C. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of minimum TS6x4x3/16”, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports and operator supports shall be factory attached.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603, Color to be selected by Architect from Manufacturer’s full range.

E. Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.

1. All hardware, including hinges and trolleys, shall be bolted to the panel for easy removal for service or panel replacement.
2. Doors up to 16’ wide and under 30psf windload shall require no floor mounted supports, guides or tracks.
3. Top tracks shall be adjustable on the end track hangers to allow for adjustment of the door panels in the open position and easily replaceable without removal of the door framing or operators.
4. Track Hood: A full width hood shall be provided to cover the exterior track and trolleys.

F. Hinges: Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Fold hinges shall be stainless steel and be dual shear with two thrust bearings. All bearings shall be completely concealed within the hinge barrel and include grease zerks. All hinge pins shall be minimum ¾” diameter hardened steel.

G. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16” cloth inserted

neoprene and include no exposed fasteners on the exterior face of the panel. Weatherstripping at sill shall include two 1/16" cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.

H. Perimeter Weatherstripping: Provide jamb and head weatherstipping of 1/16" cloth-inserted neoprene bulb (or closed cell neoprene).

I. Vision Panels: Provide 1" insulated, tempered, vision panels of the size, shape and location as noted on the drawings.

2.2 OPERATOR

A. Each Four-Fold door shall be operated by overhead mounted electro-mechanical drive units mounted on the interior face of the header. Operator consists of an electric motor, gear reducer, and rotating drive arm which folds the door to the exterior. The door shall be operated with connecting rods attached to the rotating drive arm on the operator. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.

B. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to manual operation.

C. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall be wound for three phase 208/230/480 VAC, 60 Hertz operation.

D. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards.

1. Control panel assemblies shall be UL listed as per NFPA70.
2. Controls shall include a programmable logic controller with digital message display or LED indicators. Controller shall include programmable close timers and programmable inputs/outputs.
3. Controls shall include a variable frequency drive(s) with independent adjustment of the opening and closing speeds.
4. Enclosures shall be NEMA 4 with disconnect switch.
5. Pushbuttons (interior) for each door shall have one (1) momentary pressure three-button push-button station marked "OPEN", "CLOSE" and "STOP". Push button enclosure shall be NEMA 4.
6. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
7. Safety edges: Provide monitored electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.
8. Photo eyes: Provide (1) interior, jamb mounted, light Curtain type photo eyes, NEMA 4 rated. Photo eye shall cover from floor level to 72" above floor.
9. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor BEA IS40P or equal. Doors over 16' tall shall include LZR-Widescan or equal.
10. Radio controls: Provide one (1) radio receiver and (2) single button remotes per door. Remotes to open and close doors with single button.
11. Wiring: Door manufacturer shall supply controls and components only. Electrical contractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of folding doors.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. For folding doors supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings showing locations of anchorage devices and similar items.

3.3 INSTALLATION

A. Install frame in accordance with manufacturer's recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.

B. B. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

3.4 ADJUSTING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION

SECTION 083610

SECTIONAL DOORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Electrically-motor-operated sectional overhead doors.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS for miscellaneous steel supports.
2. Section 087100 - DOOR HARDWARE for lock cylinders and keying.
3. Division 26 - ELECTRICAL for electrical service and connections for powered operators and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. Uniform pressure (velocity pressure) as required by Code but not less than 20 lbf/sq. ft. acting inward and outward.

B. Maximum Air Leakage Rate: Installed products shall comply with the following in accordance with the 2018 International Energy Conservation Code (IECC) Table C402.5.2:

1. Garage Doors: 0.40 cfm/sq.ft. per ANSI/DASMA 105, NFRC 400, or ASTM E283 at 1.57 psf.

C. Operation-Cycle Requirements: Provide sectional overhead door components and operators capable of operating for not less than 10,000 cycles.

1.4 SUBMITTALS

A. Product Data: For each type and size of sectional overhead door and accessory. Include the following:

1. Summary of forces and loads on walls and jambs.
2. Motors: Show nameplate data and ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's product data.

C. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain sectional overhead doors through one source from a single manufacturer.

1. Obtain operators and controls from sectional overhead door manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CornellCookson, Inc..
2. Overhead Door Corp.
3. Raynor Garage Door Co.
4. Wayne-Dalton Corp.

B. Basis of Design: Overhead Door Corp.; ThermaCore 596.

2.2 STEEL DOOR SECTIONS

A. Construct door sections including face sheets and frames from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, G60 coating designation.

1. Minimum Base-Metal (Uncoated) Thickness for Section Faces: 0.053 inch.
2. Panel Thickness: 2 inches.
3. Exterior-Section Face: Flat.

B. Fabricate door panels from a single sheet to provide sections not more than 24 inches high and nominally 2 inches deep. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.

1. For insulated doors, provide door sections with continuous thermal-break construction, separating faces of door.

C. Enclose open sections with channel end stiles formed from not less than 0.064-inch-thick galvanized steel sheet and weld end stiles to door section in place. Provide intermediate stiles formed from not less than 0.064-inch-thick galvanized steel sheet, cut to door section profile, and welded in place.

1. Stile Spacing: Not more than 48 inches apart.

D. Reinforce bottom section with a continuous channel or angle complying with bottom-section profile.

E. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.

F. Provide reinforcement for hardware attachment.

G. Thermal Insulation: Insulate inner core of steel sections with door manufacturer's standard polyurethane insulation, foamed in place to completely fill inner core of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections that incorporate the following inside facing material, with no exposed insulation material evident:

1. Inside Facing Material: Zinc-coated (galvanized) steel sheet with a minimum base (uncoated) metal thickness of 0.028 inch.
2. R-Value: 17.40.

H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

I. Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean galvanized surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants.

a. Pretreat zinc-coated steel, after cleaning, with a conversion coating of type suited to organic coating applied over it.

2. Apply manufacturer's standard primer and powder-coat finish to interior- and exterior-door faces after forming, according to coating manufacturer's written instructions for application, thermosetting, and minimum dry film thickness.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, and complying with ASTM A 653/A 653M for minimum G60 zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced at 2 inches apart for door-drop safety device. Slope tracks at proper angle from vertical or design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.

1. Provide low headroom track.

B. Track Reinforcement and Supports: Galvanized steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.

1. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling) tracks with continuous angle welded to track and supported by laterally braced attachments to overhead structural members at curve and end of tracks.

a. Repair galvanized coating on tracks according to ASTM A 780.

C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of overhead door.

1. Provide motor-operated doors with combination bottom weatherseal and sensor edge.
2. Provide continuous flexible seals at door jambs for a weathertight installation.

D. Full-Vision Panels: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 3/4 inch (19 mm) dual pane tempered insulated glazing.

2.4 HARDWARE

A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty galvanized steel hinges of not less than 0.0747-inch-thick, uncoated steel at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch-diameter roller tires for 3-inch-wide track and 2-inch-diameter roller tires for 2-inch- wide track.

D. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.

E. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

F. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks. Lock cylinder is specified in Section 087100 - DOOR HARDWARE.

G. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.5 COUNTERBALANCE MECHANISM

A. Extension Spring: Counterbalance mechanism with aircraft-type steel cable over ball-bearing sheaves. Provide oil-tempered wired springs with internal safety rods. Combine operation with a spring bumper in each horizontal track to cushion door at end of opening operation.

B. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from oil-tempered-steel wire complying with ASTM A 229/A 229M, Class II, mounted on a cross-header tube or steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Provide springs calibrated for a minimum of 10,000 cycles.

C. Cable Drums: Cast-aluminum or gray-iron casting cable drums grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.

D. Cable Safety Device: Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either cable breaks.

E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level shaft and prevent sag.

F. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.6 ELECTRIC DOOR OPERATORS

A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Basis of Design: Model RSX.

B. Comply with NFPA 70.

C. Disconnect Device: Hand-operated disconnect device or mechanism for automatically engaging chain-and-sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect device and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24-V, ac or dc.

F. Electric Motors: High-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or service factor.

1. Type: Polyphase, medium-induction type.
2. Service Factor: Comply with NEMA MG 1, unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.

G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."

H. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.

I. Limit Switches: Adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install door, track, and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.

B. Fasten vertical track assembly to framing, spaced not less than 24 inches apart. Hang horizontal track from structural overhead framing with angle or channel hangers fastened to framing by welding or bolting or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Protect doors and tracks against damage from construction operations and placement of equipment and fixtures during the remainder of construction period.

3.2 ADJUSTING

A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and with weathertight fit around entire perimeter.

B. Adjust belt-driven motors as follows:

1. Use adjustable motor-mounting bases for belt-driven motors.
2. Align pulleys and install belts.
3. Tension belt according to manufacturer's written instructions.

C. Touch-up Painting: Immediately after welding galvanized track to track supports, clean field welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain sectional overhead doors.

END OF SECTION

SECTION 084110

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Exterior and interior aluminum-framed storefronts.
2. Exterior and interior manual-swing aluminum doors.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 079200 - JOINT SEALANTS for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
2. Section 087100 - DOOR HARDWARE for lock cylinders and keying.
3. Section 088000 - GLAZING for glazing requirements to the extent not specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design entrance and storefront system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Dimensional tolerances of building frame and other adjacent construction.
4. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferred to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Sealant failure.
g. Failure of operating units to function properly.

C. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch and clearance between members and operable units directly below to less than 1/16 inch.

E. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Air Infiltration: Provide doors and storefront which comply with the following. Test unit in accordance with ASTM E 283.

1. Swinging Entrance Doors, ASHRAE Requirement: 1.0 cfm/sf maximum air leakage at a pressure differential of 1.57 psf.
2. Storefront, ASHRAE Requirement: 0.06 cfm/sf maximum air leakage at a pressure differential of 1.57 psf or higher.

G. Water Leakage Test: Test fixed framing system in accordance with ASTM E 331.

1. Test Pressure: 8 psf.
2. Performance: No leakage as defined in test method at specified test pressure. No uncontrolled water penetrating system or appearing on normally exposed interior surfaces.

H. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

I. Thermal Transmittance: Provide window units that have a U-value as required by Code rated in BTU/hour/sq. ft./degrees F at 15-mph exterior wind velocity, when tested in accordance with AAMA 1503.1. Test unit to be 4 ft. x 6 ft. Submit proof of compliance with submittals as specified.

J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 65 for fixed storefront units and not less than 55 for doors when tested according to AAMA 1503.

1.4 SUBMITTALS

A. Product Data: Include installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated. Indicate special procedures and perimeter conditions requiring special attention.

B. Shop Drawings: Prepared under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum-framed systems. For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.
3. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
4. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
5. Wiring diagrams for power, signal, and control wiring.
6. Activation and safety devices.
7. Include full-size isometric details of each vertical-to-horizontal intersection of storefronts, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions
    d. Glazing
    e. Flashing and drainage.

8. Include details showing interface with perimeter conditions to depict interface with adjacent thermal, weather, air and vapor barriers, and adjacent flashings.
9. Shop drawings must be signed and stamped by a professional engineer.

C. Delegated-Design Submittal: For entrance and storefront systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Show structural testing for attachment of the storefront to the existing structure. Contractor should survey slab edge locations and conditions of the embeds to develop the attachment details.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

G. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:

1. U-value.
2. Solar heat-gain coefficient.

H. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of entrance and storefront systems that are similar to those indicated for this Project in material, design, and extent.

C. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.

D. Accessible Entrances: Comply with authorities having jurisdiction, local state building code and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

E. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to storefront system, including, but not limited to, the following:

1. Review structural load limitations.
2. Review and finalize construction schedule and verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing, inspection, and certifying procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Faulty operation of operators, controls, and hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Storefront, Thermal Break, 2 inch by 4-1/2 inch profile:

a. EFCO Corporation, 403X.
b. Kawneer North America, 451UT.
c. Oldcastle BuildingEnvelope, 3000XT.
d. Tubelite Inc., TU24000.
e. YKK AP America Inc., YES 45 XT.

2. Doors, Medium Stile, Thermally-Broken:

a. EFCO Corporation, D-302.
b. Kawneer North America, Insulpour 350T.
c. Oldcastle BuildingEnvelope, MS-375TC.
d. Tubelite Inc., Medium Thermal Block.
e. YKK AP America Inc., 35XT.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Dual thermal-break.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 - GLAZING.

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 DOORS

A. Doors: Manufacturer's standard glazed doors, for manual swing operation.

1. Door Construction: Mechanical clip fastening, SIGMA deep penetration plus welds and 1-1/8 inch long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type and EPDM glazing gaskets reinforced with non-stretchable cord.

2.6 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

1. Opening-Force Requirements:

a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf.

B. Pivot Hinges: BHMA A156.4, Grade 1.

C. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation.

1. Opening-Force Requirements:

a. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
b. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.

D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

E. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

1. Standard: BHMA A156.3, Grade 1.

F. Cylinders: As specified in Section 087100 - DOOR HARDWARE.

G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

H. Operating Trim: BHMA A156.6.

I. Closers: With accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use, and adjustable to meet field conditions and requirements for opening force.

1. Standard: BHMA A156.4, Grade 1.

J. Concealed Overhead Holders: BHMA A156.8, Grade 1.

K. Surface-Mounted Holders: BHMA A156.16, Grade 1.

L. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

M. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

N. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

O. Silencers: BHMA A156.16, Grade 1.

P. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).

1. Standard: BHMA A156.21.

Q. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

A. Insulating Materials: As specified in Section 072100 - THERMAL INSULATION.

B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 - JOINT SEALANTS.

C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Doors: Reinforce doors as required for installing hardware.

1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Coatings shall be fluorosurfactant free Kynar 500 by Arkema or fluorosurfactant-compliant Hylar 5000 by Solvay; or equal. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 - JOINT SEALANTS and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Section 088000 - GLAZING.

1. Structural-Sealant Glazing:

a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
b. Install weatherseal sealant according to Section 079200 - JOINT SEALANTS and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under Part 1 "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under Part 1 "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.

3. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING

A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION

SECTION 085413

FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Fixed and operable fiberglass windows with factory-installed glass and glazing.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 076200 - SHEET METAL FLASHING AND TRIM.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:

1. Minimum size required by AAMA/NWWDA 101/I.S.2.

B. AAMA/NWWDA Performance Requirements: Provide windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.

1. Performance Class: C - Commercial.
2. Performance Grade: Minimum for performance class indicated.
3. Exception to AAMA/NWWDA 101/I.S.2: In addition to requirements for performance class and performance grade, design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on Code requirements.

C. Structural Performance: Provide windows capable of withstanding the following, including wind loads based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Structural Test, at basic wind speed indicated and as required by Code:

1. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on structural computations.
2. Wind and Seismic Loads: As indicated on the Structural Drawings, but not less than that required by Code.

3. Movements of supporting structure including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads of 3/4 inches. Deflection over 3/4 inches will require special considerations including but not limited to head receptors.

D. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/NWWDA 101/I.S.2, Air Infiltration Test.

1. Maximum Rate: As required by Code.

E. Water Resistance: No water leakage as defined in AAMA/NWWDA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/NWWDA 101/I.S.2, Water Resistance Test.

1. Test Pressure: 15 percent of positive design pressure, but not less than 2.86 lbf/sq. ft. or more than 12 lbf/sq. ft..

F. Condensation-Resistance Factor: Provide windows tested for thermal performance according to AAMA 1503, showing a CRF of 52 where windows are indicated to be "thermally improved."

G. Thermal Transmittance: Provide windows with a whole-window U-value maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.

1. U-Value: As required by Code. Submit proof of compliance with submittals as specified.

H. Solar Heat-Gain Coefficient: Provide windows with a whole-window SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

I. Thermal Movements: Provide windows, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints, failure of joint sealants, damaging loads and stresses on glazing and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
3. Expansion provisions.
4. Flashing and drainage details.
5. Weather-stripping details.
6. Glazing details.
7. Window cleaning provisions.

8. Window System Operators: Show locations, mounting, and details for installing operator components and controls.
9. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used to determine the following:

    a. Structural test pressures and design pressures from basic wind speeds indicated.
    b. Deflection limitations of glass framing systems.

C. Samples for Verification:

1. Full-size operable window of each type of window.
2. Glazing: Minimum 12 inch square sample of proposed insulated glazing.

D. Qualification Data: For Installer, professional engineer and testing agency.

E. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

F. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of window. Test results based on use of down-sized test units will not be accepted.

G. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that windows as glazed for this Project meet or exceed Code requirements for the following:

1. U-value.
2. Solar heat-gain coefficient.

H. Maintenance Data: For operable window sash, operating hardware, weather stripping, and finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to window manufacturer for installation of units required for this Project.

B. Source Limitations: Obtain windows through one source from a single manufacturer.

C. Product Options: Information on Drawings and in Specifications establishes requirements for windows' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

D. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Provide AAMA certified windows with an attached label.

E. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup for types of windows indicated, in locations shown on Drawings.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to windows including, but not limited to, the following:

1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing and inspecting procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace windows that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Failure to meet performance requirements.
2. Structural failures including excessive deflection.
3. Water leakage, air infiltration, or condensation.
4. Faulty operation of movable sash and hardware.
5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
6. Insulating glass failure.

B. Warranty Period: Twenty years from date of Substantial Completion.

C. Warranty Period for Fiberglass Finishes: Ten years from date of Substantial Completion.

D. Warranty Period for Glass: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fiberglass Windows:

    a. Fibertec Window & Door Mfg.
    b. Inline Fiberglass Ltd.
    c. Marvin Windows and Doors.
    d. Pella Corporation.

B. Basis of Design: Marvin Windows and Doors.

2.2 MATERIALS

A. Frame and sash profiles are made from pultruded fiberglass, nominal wall thickness of 0.090 in., with a minimum glass content of 60%. Non-structural accessory members are permitted to be in vinyl or aluminum and are identified as such.

2.3 GLAZING

A. Insulating-Glass Units for Vertical Glazing: 1 inch thick insulating glass consisting of two lites of 1/4 inch glass, low e coating on the No. 2 surface and argon gas filled.

1. Tinted Glass: To be selected by Architect from Manufacturer's full range.
2. Provide obscured decorative glazing in lower lite at windows in bathing rooms. Pattern to be selected by Architect from Manufacturer's full range.

B. Provide one of the following or equal:

1. VE1-2M by Viracon.

    a. Visible Light Transmittance: 70 percent.
    b. Reflectance Visible Light: 11 percent.
    c. U Value (Winter): 0.25.
    d. Shading Coefficient: 0.43.
    e. Solar Heat Gain Coefficient: 0.37.

2. Solarban 60 by PPG Industries.

    a. Visible Light Transmittance: 70 percent.
    b. Reflectance Visible Light: 11 percent.
    c. U Value (Winter): 0.29.
    d. Shading Coefficient: 0.44.
    e. Solar Heat Gain Coefficient: 0.38.

3. SN-68 by Guardian Industries.

    a. Visible Light Transmittance: 68 percent.
    b. Reflectance Visible Light: 10 percent.
    c. U Value (Winter): 0.29.
    d. Shading Coefficient: 0.43.
    e. Solar Heat Gain Coefficient: 0.37.

C. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.4 HARDWARE

A. Hardware Requirements: Provide hardware that complies with AAMA/NWWDA 101/I.S.2.

2.5 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Provide for each operable exterior sash or ventilator.

B. Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
2. Finish: Match window members.

C. Stainless-Steel Wire Fabric: 18-by-16 mesh of 0.009-inch-diameter, nonmagnetic stainless-steel wire, Type 304 or 316, complying with FS RR-W-365, Type VI.

D. Wickets: Provide sliding wickets, framed and trimmed for a tight fit and durability during handling.

2.6 ACCESSORIES

A. Grids: Removable grids and simulated divided lites including spacer bar as indicated on the Drawings. Color as selected by Architect.

2.7 FABRICATION

A. General: Fabricate fiberglass windows, in sizes indicated, that comply with AAMA/NWWDA 101/I.S.2 for performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.

B. Construction: Connect frame and sash corners with molded reinforced polymer shearblocks and mechanical fasteners. Factory seal and neatly fit joints. Fill the perimeter of open-back frames with insulation and injected urethane foam in four corners.

C. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

D. Weep Holes: Provide concealed weep holes and internal passages to conduct infiltrating water to exterior.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Aluminum Brake Metal Trim Work: Provide aluminum brake metal work in conjunction with aluminum windows. Fabricate brake-metal work from minimum 0.062 in. thick aluminum sheet, finished to match windows.

G. Factory-Glazed Fabrication: Glaze fiberglass windows in the factory where practical and possible for applications indicated. Comply with AAMA/NWWDA 101/I.S.2.

2.8 FINISHES

A. Finish System: Manufacturer's standard factory applied acrylic urethan finish meeting requirements of AAMA 624-10.

1. Color and Gloss: As selected by Designer from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances; and other conditions affecting performance of work.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components; Drawings; and Shop Drawings.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.

2. Air-Infiltration Testing:

   a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
   b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

   a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
   b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
5. Test Reports: Prepared according to AAMA 502.

C. Remove and replace noncomplying windows and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operating sashes and ventilators, screens, hardware, operators, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.5 PROTECTION AND CLEANING

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 085680

SERVICE WINDOWS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Aluminum, medium-duty commercial sliding service windows as indicated in drawings and in sections.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for service windows.

B. Shop Drawings: For service windows.

1. Include plans, elevations, sections, and attachment details.
2. Glazing details.

C. Certification: Provide printed data in sufficient detail to indicate compliance with the contract documents.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify service window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.6 COORDINATION

A. Coordinate installation of anchorages for windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace service windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SERVICE WINDOWS

A. Manufacturers:

1. C.R. Laurence Co., Inc.
2. Hope's Windows Inc.
3. QuikServ Windows.
4. Ready Access.

B. Basis of design: C.R. Laurence Co., Inc.; SW1800, Sliding Service Window without Screen.

C. Materials:

1. Frames: Aluminum frame modules shall be constructed of 6063-T5 extruded aluminum. Window glides on top-hung nylon slides. Poly-pile weather stripping and slide locks. Overall frame sizes are to be in accordance with the contract drawings.
2. Finish: All aluminum to be clear.
3. Glazing: 1/4 inch tempered glazing.
4. Track Type: Half track.

2.2 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.3 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of service windows.

B. Examine roughing-in for embedded anchors to verify actual locations of service window connections before service window installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of service windows.

D. For glazing materials whose orientation is critical for performance, verify installation orientation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install service windows level, plumb, rigid, properly aligned, and securely fastened in place, complying with Drawings, Coordination Drawings, and manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust operating ventilators and hardware to provide a tight fit at contact points and weather stripping, for smooth operation and a weathertight enclosure.

B. Remove and replace defective work, including service windows that are warped, bowed, or otherwise unacceptable.

3.4 CLEANING AND PROTECTION

A. Clean surfaces promptly after installation of service windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.

B. Provide temporary protection to ensure that service windows are without damage at time of Substantial Completion.

END OF SECTION

SECTION 086200

UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Prefabricated, unit skylights at roof.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Division 07 for roofing and joint sealants.
2. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for roof flashing.
3. Section 079200 - JOINT SEALANTS for perimeter joint sealants.

1.3 SUBMITTALS

A. Product Data: Submit complete manufacturer's product data to Architect for approval, consisting of complete product description and specifications, complete test data and technical characteristics, installation instructions, complete maintenance instructions, and other pertinent technical data required for complete product and product use information.

B. Shop Drawings: Submit complete shop drawings of all work of this Section to Architect for approval, showing large scale details of construction and methods of installation and anchorage, including types, sizes, thicknesses, shapes, and finishes of all materials; anchorage; closures; flashings; sealing; and relationship to surrounding work by other trades. Sufficient typical and special conditions shall be shown to fully establish the design, quality, character, and weathertight integrity of the proposed installation.

1.4 QUALITY ASSURANCE

A. The manufacturer shall be responsible for the configuration, fabrication, and performance of the unit skylights, in general conformance with the Contract Documents.

B. The manufacturer shall be able to identify at least five projects in the regional area where unit skylights of similar type and size have been installed and have performed satisfactorily since their installation, for a period of at least the last ten consecutive years.

1.5 TESTS AND PERFORMANCE REQUIREMENTS

A. Manufacturer's Standard Tests: Provide manufacturer's standard test data showing compliance with code requirements. Provide specified tests if manufacturer's standard skylight units have been modified, or when custom skylights are used.

B. Skylight system shall be designed for design loads for snow, wind, etc., established by the governing laws and the applicable building code, with a maximum deflection of L/175 of the unsupported span of any member, and without cracking or breakage of glazing material, permanent deformation of any member, exceeding of the ultimate tensile strength of any member, or failure of any fastening or anchor.

1. Plastic unit skylights shall not transmit any horizontal loads to structure.

1.6 COORDINATION

A. Coordinate work of this Section with work of other trades affecting, or affected by, this work to assure the steady progress of all the work of the Contract.

B. Before proceeding with installation work inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section, and notify the Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Package and deliver all materials, and store and handle in such manner, as to assure complete protection of all materials from damage.

B. Store skylights several inches above the ground, blocked and under cover to prevent warping. Clean all aluminum and panels before installation, and maintain all joint surfaces thoroughly clean until sealants are applied.

1.8 WARRANTY

A. Include written warranty, signed by manufacturer, installer and Contractor, covering defects of materials and workmanship for a period of ten years from the date of Substantial Completion of Project.

B. Include manufacturer's standard written warranty covering defects of insulating skylight for a period of ten years against breakage, delamination, or seal failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bristolite Skylights.
2. Wasco.
3. Velux America Inc.

B. Basis of Design: Velux America Inc.; Fixed Curb Mount (FCM) Unit Skylight.

2.2 SKYLIGHTS

A. Factory-Fabricated Skylights:

1. Sizes: As indicated on the Drawings.
2. Aluminum members shall be extruded 6063 aluminum conforming to ASTM B 221, with a minimum thickness of 0.094 in.
3. Counterflashing: Aluminum, 15 gauge, 0.06 inch thick with neutral gray high performance coating.
4. Condensation Drainage Gasket: Factory applied black thermoplastic rubber gasket.
5. Glazing: Comply with minimum requirements of ASHRAE 90.1-2004, and as follows:

    a. Exterior Pane: Minimum 0.125 tempered glass, interior surface coated with three layers of low-e coatings.
    b. Fill: Argon fill.
    c. Interior Pane: Tempered, clear 0.125inch tempered glass.

6. Structural Sealant: Factory applied silicone sealant, black color, bonding glass pane to aluminum frame and suitable for external exposure.
7. Fasteners: Stainless steel with black zinc coating.
8. Flashings: As recommended by manufacturer for application indicated.
9. Accessories: As required for complete installation.
10. Fall Protection Standard Compliance: 29 CFR 1910.23.
11. Finish: Finish shall be selected by Architect from manufacturer's standard finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Unit skylights shall be installed in strict accordance with the approved shop drawings and the manufacturer's printed installation instructions by the skylight manufacturer utilizing his own fully experienced, adequately supervised, erection crews. Installation shall be complete in all respects, including all framing and all related aluminum closures, flashings, fillers, fastenings, anchors, sealing, required for a complete weathertight installation, including sealing between the skylight system components and the surrounding construction.

B. Provide positive and adequate fastening and anchorage of all components, including fastening into existing construction. Work shall not void the warranty provisions of existing roof construction.

C. Contact surfaces between aluminum and dissimilar materials shall be protected with coating of bituminous mastic or application of nonabsorptive, dielectric tape for prevention of electrolytic action and corrosion. Do not use bituminous mastic where it might contaminate a joint or surface to receive sealant.

3.3 SEALING

A. Do all metal-to-metal sealing required to assure thoroughly weathertight installations throughout, as recommended by sealant manufacturer and conforming to the general procedures specified under Section 079200 - JOINT SEALANTS.

3.4 PROTECTION AND CLEANING OF ALUMINUM

A. Protect finished metal surfaces from damage during fabrication, shipping, storage, and erection, and from then until acceptance by Owner.

B. Clean all metal and glazing surfaces promptly after installation. Remove excess sealant, dirt, and other substances.

3.5 PROTECTION AND CLEANING OF GLAZING

A. Replace all glazing which is broken, cracked, or chipped prior to time of final acceptance of Project by Owner.

B. Clean glazing surfaces promptly after installation, exercising care to avoid damage to same.

END OF SECTION

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.
      10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
   b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Final approved hardware schedule edited to reflect conditions as installed.
d. Final keying schedule
e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.

b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Schlage L Series: 10 years
            b) Schlage ND Series: 10 years
        2) Exit Devices
            a) Falcon: 10 years
        3) Closers
            a) Falcon SC Series: 10 years
        4) Automatic Operators
            a) LCN: 2 years
    b. Electrical Warranty

1) Locks
   a) Schlage: 3 year
2) Exit Devices
   a) Von Duprin: 3 year

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of alternate manufacturers and/or products other than those listed as ''Scheduled Manufacturer'' or ''Acceptable Manufacturers'' in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

B. Approval of products from manufacturers indicated in ''Acceptable Manufacturers'' is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:
   a. Hager BB1191/1279 series
   b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Select
   b. Best

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:
   a. Security Door Controls PTM
   b. Precision EPT-12C

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage L9000 series

2. Acceptable Manufacturers and Products:
   a. Best 45H series
   b. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide motor based electrified locksets that comply with the following requirements:
   a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
   b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
   c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
   d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
   e. Connections – provide quick-connect Molex system standard.

8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
   a. Lever Design: Tubular.

2.08 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage ND series

2. Acceptable Manufacturers and Products:
   a. Sargent 11-Line
   b. Corbin-Russwin CL3100 series

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
   a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
   b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
   c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
   d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
   e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Lever Design: Tubular.

2.09 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Falcon 24/25 series

2. Acceptable Manufacturers and Products:
   a. Sargent 19-43-GL-80 series

b. Precision Apex series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer's approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:
   a. Securitron BPS series
   b. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.
   c. Universal 120-240 VAC input.

d. Low voltage DC, regulated and filtered.
e. Polarized connector for distribution boards.
f. Fused primary input.
g. AC input and DC output monitoring circuit w/LED indicators.
h. Cover mounted AC Input indication.
i. Tested and certified to meet UL294.
j. NEMA 1 enclosure.
k. Hinged cover w/lock down screws.
l. High voltage protective cover.

2.11 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage Everest 29 T

2. Acceptable Manufacturers and Products:
   a. Best CORMAX
   b. Medeco Keymark

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
   a. Patented Restricted: cylinder with interchangeable core with patented, restricted keyway.

3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.12 KEYING

A. Scheduled System:

1. New factory registered system:
   a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
   d. Identification:
      1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
      2) Identification stamping provisions must be approved by the Architect and Owner.
      3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
      4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
      5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
   e. Quantity: Furnish in the following quantities.
      1) Permanent Control Keys: 3.
      2) Master Keys: 6.
      3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
      4) Key Blanks: Quantity as determined in the keying meeting.

2.13 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Telkee

2. Acceptable Manufacturers:
   a. HPC
   b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
   a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
   b. Provide hinged-panel type cabinet for wall mounting.

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Falcon SC70A series

2. Acceptable Manufacturers and Products:
   a. Norton 7500 series
   b. Yale 4400 series.

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with aluminum cylinder.
3. Closer Body: 1-1/2-inch (38 mm) diameter with 5/8-inch (16 mm) diameter heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.15 ELECTROMECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN Senior Swing

2. Acceptable Manufacturers and Products:
   a. Besam Swingmaster MP
   b. Horton 4000LE series

B. Requirements:

1. Provide low energy automatic operator units that are electromechanical design complying with ANSI/BHMA A156.19.
   a. Opening: Powered by DC motor working through reduction gears.
   b. Closing: Spring force.
   c. Manual, hydraulic, or chain drive closers: Not permitted.
   d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
   e. Cover: Aluminum.

2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 1 to 32 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, and adapters for arms as required to suit details.

4. Provide motion sensors and/or actuator switches, and receivers for operation as specified. Provide weather-resistant actuators at exterior applications.
5. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to "KEYING" article, herein.
6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

2.16 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.17 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.18 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. Rixson
   b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.19 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.20 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Reese

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.21 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.22 ROLLER LATCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide roller latches with 4-7/8 inches (124 mm) strike at single doors to fit ANSI frame prep. If dummy levers are used in conjunction with roller latch mount roller latch at a height as to not interfere with proper mounting and height of dummy lever.
2. Provide roller latches with 2-1/4 inches (57 mm) full lip strike at pair doors. Mount roller in top rail of each leaf per manufacturer's template.

2.23 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. LCN

2. Acceptable Manufacturers:
   a. Rixson
   b. Sargent

B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.24 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Schlage

2. Acceptable Manufacturers:
   a. GE-Interlogix
   b. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.25 FINISHES

A. FINISH: BHMA 619/646 (US15); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Door Closers: Powder Coat to Match
4. Latch Protectors: BHMA 630 (US32D)
5. Weatherstripping: Clear Anodized Aluminum
6. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

HARDWARE GROUP NO. N01 - ALUM, EXTERIOR, PANIC, CARD
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	027XY EPT	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	RX-FSE-25-R-L 24 VDC	FAL
1	EA	MORTISE/ RIM CYLINDER	AS REQUIRED	SCH
1	EA	OH STOP	CONCEALED HEAVY DUTY 100S SERIES	GLY
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	DRIP CAP	142	ZER
1	SET	SEALS	BY ALUMINUM DOOR SUPPLIER	
1	EA	DOOR SWEEP	39	ZER
1	EA	THRESHOLD	8724A	ZER
1	EA	DOOR CONTACT	BY SYSTEM INTEGRATOR	SCE
1	EA	POWER SUPPLY	BY SYSTEM INTEGRATOR	MIS
1	EA	CARD READER/KEYPAD	BY SYSTEM INTEGRATOR	BYO
1	EA	REMAINING HARDWARE	BY DOOR MANUFACTURER	EXI

ALL WIRING AND CONNECTIONS BY OTHERS.
OPERATIONAL DESCRIPTION:
IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY OR BY ACCESS CONTROL SYSTEM CARD READER. CARD READER TO UNLOCK ELECTRIC LATCH RETRACTION AND ALLOW ACCESS. DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM SPECIFIED IN SEPARATE SECTION. INTERCOM AT OPENINGS BY OTHERS. OPENING ALSO CONTROLLED VIA RECEPTION RELEASE BUTTON. LOCATION IN DISPATCH PER ARCHITECT. INSTALL PULL TO ALLOW ACCESS TO KEY CYLINDER.

HARDWARE GROUP NO. N02X - ALUM, EXTERIOR, PANIC, CARD AUTO OPERATOR
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	027XY EPT	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	RX-MEL-24-R-L-BE-QUA 24 VDC	FAL
1	EA	MORTISE/ RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURF. AUTO OPERATOR	9540 SERIES (PUSH SIDE MOUNTED)	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852/8310-818 AS REQUIRED	LCN
1	EA	DRIP CAP	142	ZER
1	SET	SEALS	BY ALUMINUM DOOR SUPPLIER	
1	EA	DOOR SWEEP	39	ZER
1	EA	THRESHOLD	8724A	ZER
1	EA	DOOR CONTACT	BY SYSTEM INTEGRATOR	SCE
1	EA	POWER SUPPLY	BY SYSTEM INTEGRATOR	MIS
1	EA	INTERCOM	BY OTHERS	

NOTE: AIPHONE - WHERE INDICATED BY OTHERS.
ALL WIRING AND CONNECTIONS BY OTHERS.
OPERATIONAL DESCRIPTION:
IMMEDIATE EGRESS ALWAYS ALLOWED. DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM SPECIFIED IN SEPARATE SECTION. INTERCOM AT OPENINGS BY OTHERS. ACTUATOR TO RETRACT EXIT DEVICE LATCH BOLT AND ACTIVATE AUTO OPERATOR.

HARDWARE GROUP NO. N07 - (EXTERIOR SINGLE WITH ELECTRIFIED RIM PANIC HARDWARE X CARD READER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	RX-FSE-25-R-L 24 VDC	FAL
1	EA	MORTISE/ RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURFACE CLOSER	SC71A SS	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	DRIP CAP	142	ZER
1	SET	GASKETING	429	ZER
1	EA	DOOR SWEEP	39	ZER
1	EA	THRESHOLD	8724A	ZER
1	EA	DOOR CONTACT	BY SYSTEM INTEGRATOR	SCE
1	EA	POWER SUPPLY	BY SYSTEM INTEGRATOR	MIS
1	EA	WIRING ELEVATION AND POINT-TO-POINT WIRING DRAWINGS	AS REQUIRED	
1	EA	CARD READER/KEYPAD	BY SYSTEM INTEGRATOR	BYO

ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY OR BY CARD READER. CARD READER WILL RETRACT EXIT DEVICE LATCHBOLT AND ALLOW ACCESS. REQUEST TO EXIT AND DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.

HARDWARE GROUP NO. N08 - (SINGLE VESTIBULE WITH ELECTRIFIED RIM PANIC HARDWARE X CREDENTIAL READER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	RX-FSE-25-R-L 24 VDC	FAL
1	EA	RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURFACE CLOSER	SC71A SS	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64/65 AS REQ	IVE
1	EA	DOOR CONTACT	679-05HM/WD	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	VON
1	EA	WIRING ELEVATION AND POINT-TO-POINT WIRING DRAWINGS	AS REQUIRED	

ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
• DOOR IS NORMALLY CLOSED AND LOCKED.
• DOOR CAN BE UNLOCKED BY VALID CREDENTIAL. VALID CREDENTIAL WILL RETRACT LATCH AND ALLOW ENTRY.
• REQUEST TO EXIT AND DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.
• KEY OVERRIDE FOR MECHANICAL ENTRY.
• FREE EGRESS ALWAYS ALLOWED.
• DOOR REMAINS LOCKED UPON ACTIVATION OF FIRE ALARM.

HARDWARE GROUP NO. N10 - (SINGLE WITH PUSH/PULL)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	DOOR PULL	8103EZ -0	IVE
1	EA	PUSH PLATE	8200	IVE
1	EA	SURFACE CLOSER	SC71A SSHO	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER
1	EA	DOOR SWEEP	39	ZER

HARDWARE GROUP NO. N11 - (SINGLE WITH PUSH/PULL)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	DOOR PULL	8103EZ -0	IVE
1	EA	PUSH PLATE	8200	IVE
1	EA	SURFACE CLOSER	SC71A SSHO	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	GASKETING	488S	ZER
1	EA	DOOR SWEEP	39	ZER

HARDWARE GROUP NO. N11.1 - (SINGLE WITH DUMMY LEVER X ROLLER LATCH)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	ROLLER LATCH	RL32A	IVE
1	EA	SINGLE DUMMY TRIM	ND170	SCH
1	EA	DOOR STOP	60/70 AS REQUIRED	IVE
3	EA	SILENCER	SR64/65 AS REQ	IVE

HARDWARE GROUP NO. N12 - (SINGLE WITH PASSAGE SET)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	PASSAGE SET	ND10	SCH
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. N12.1 - (SINGLE WITH PASSAGE SET)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	PASSAGE SET	ND10	SCH
1	EA	ROLLER BUMPER	RB471	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. N12.2 - (SINGLE WITH PASSAGE SET X CLOSER X SMOKE GASKETING X MAG HOLDER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	PASSAGE SET	ND10	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	MAGNETIC HOLDER	SEM7800 SERIES AS REQUIRED	LCN
1	EA	GASKETING	488S	ZER
1	EA	DOOR SWEEP	39	ZER
1	EA	THRESHOLD	545/547/548 (VERIFY JAMB DEPTH)	ZER
1	EA	WIRING ELEVATION AND POINT-TO-POINT WIRING DRAWINGS	AS REQUIRED	

ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
• DOOR NORMALLY HELD OPEN BY MAGNETIC HOLDER.
• MAGNETIC HOLDER TO BE CONNECTED TO BUILDING'S FIRE/SMOKE ALARM SYSTEM TO RELEASE IMMEDIATELY UPON ACTIVATION.

HARDWARE GROUP NO. N14.2 - (SINGLE WITH OFFICE LOCKSET)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	ENTRANCE LOCK	ND53	SCH
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64/65 AS REQ	IVE

HARDWARE GROUP NO. N14.3 - (SINGLE WITH OFFICE LOCKSET)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	ENTRANCE LOCK	ND53	SCH
1	EA	ROLLER BUMPER	RB471	IVE
3	EA	SILENCER	SR64/65 AS REQ	IVE

HARDWARE GROUP NO. N16 - (SINGLE WITH PUSH/PULLS X SOUND GASKETING)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	DOOR PULL	8103EZ -0	IVE
1	EA	PUSH PLATE	8200	IVE
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER
1	EA	DOOR BOTTOM	369AA-Z49	ZER

HARDWARE GROUP NO. N17.1 - (SINGLE WITH PASSAGE SET X CLOSER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	PASSAGE SET	ND10	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER

HARDWARE GROUP NO. N19 - (SINGLE WITH PASSAGE SET X CLOSER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	PASSAGE SET	ND10	SCH
1	EA	OH STOP	CONCEALED HEAVY DUTY 100S SERIES	GLY
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	GASKETING	488S	ZER

HARDWARE GROUP NO. N20 - (SINGLE WITH PRIVACY SET X CLOSER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	PRIVACY LOCK WITH OUTSIDE INDICATOR	L9040 L583-363 L283-722	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. N27 - (SINGLE WITH STOREROOM LOCKSET X CLOSER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. N28 - (SINGLE WITH STOREROOM LOCKSET X CLOSER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. N30 - (SINGLE WITH STOREROOM LOCKSET W/TACTILE WARNING X CLOSER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	STOREROOM LOCK	ND80 X TACTILE WARNING	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER

HARDWARE GROUP NO. N30.2 - (SINGLE WITH STOREROOM LOCKSET W/TACTILE WARNING X CLOSER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER

HARDWARE GROUP NO. N30.3 - (SINGLE WITH FAIL SECURE ELECTRIFIED LOCKSET X CLOSER X CREDENTIAL READER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	EU STOREROOM LOCK	RX-ND80EU	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64/65 AS REQ	IVE
1	EA	DOOR CONTACT	679-05HM/WD	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC	SCE
1	EA	CREDENTIAL READER	SPECIFIED ELSEWHERE	
1	EA	WIRING ELEVATION AND POINT-TO-POINT WIRING DRAWINGS	AS REQUIRED	

HARDWARE GROUP NO. N31 - (PAIR WITH STOREROOM LOCKSET W/ TACTILE WARNING X CONSTANT LATCHING BOLTS X CLOSER)
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
2	EA	CONST LATCHING BOLT	FB51P	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80 X TACTILE WARNING	SCH
2	EA	SURFACE CLOSER	SC71A SS	FAL
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	GASKETING	488S	ZER
1	EA	GASKETING	8217SBK PSA	ZER

223B: CLOSERS TO BE TEMPLATED FOR 180 DEGREE SWING.

HARDWARE GROUP NO. N31.2 - (PAIR WITH STOREROOM LOCKSET W/ TACTILE WARNING X CONSTANT LATCHING BOLTS X CLOSER)
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
2	EA	CONST LATCHING BOLT	FB51P	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80 X TACTILE WARNING	SCH
2	EA	SURFACE CLOSER	SC71A SS	FAL
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	GASKETING	488S	ZER
1	EA	GASKETING	8217SBK PSA	ZER

HARDWARE GROUP NO. N37.1 - (SINGLE WITH RIM PANIC HARDWARE)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	PANIC HARDWARE	25-R-L-BE	FAL
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64/65 AS REQ	IVE

HARDWARE GROUP NO. N38 - (SINGLE WITH RIM FIRE EXIT HARDWARE X SMOKE GASKETING)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	FIRE EXIT HARDWARE	F-25-R-L-BE	FAL
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER
1	EA	DOOR SWEEP	8192BK	ZER

HARDWARE GROUP NO. N38.3 - (SINGLE WITH RIM FIRE EXIT HARDWARE WITH TACTILE WARNING)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	FIRE EXIT HARDWARE	F-25-R-L-NL X TACTILE WARNING	FAL
1	EA	RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER

NOTE: TEMPLATE CLOSER FOR 180-DEGREE SWING.

HARDWARE GROUP NO. N39 - (SINGLE WITH ELECTRIFIED RIM PANIC HARDWARE X CREDENTIAL READER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	RX-FSE-25-R-L 24 VDC	FAL
1	EA	RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64/65 AS REQ	IVE
1	EA	DOOR CONTACT	679-05HM/WD	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC	VON
1	EA	CREDENTIAL READER	SPECIFIED ELSEWHERE	
1	EA	WIRING ELEVATION AND POINT-TO-POINT WIRING DRAWINGS	AS REQUIRED	

ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
• DOOR IS NORMALLY CLOSED AND LOCKED.
• DOOR CAN BE UNLOCKED BY VALID CREDENTIAL. VALID CREDENTIAL WILL UNLOCK TRIM TO ALLOW ENTRY.
• REQUEST TO EXIT AND DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.
• KEY OVERRIDE FOR MECHANICAL ENTRY.
• FREE EGRESS ALWAYS ALLOWED.
• DOOR REMAINS LOCKED UPON ACTIVATION OF FIRE ALARM.

HARDWARE GROUP NO. N40 - (SINGLE WITH FAIL SAFE ELECTRIFIED RIM FIRE EXIT HARDWARE X SMOKE GASKETING X CREDENTIAL READER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	RX-FSA-25-R-L 24 VDC	FAL
1	EA	RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	GASKETING	488S	ZER
1	EA	DOOR CONTACT	679-05HM/WD	SCE
1	EA	POWER SUPPLY	PS902 900-FA 120/240 VAC	VON
1	EA	CREDENTIAL READER	SPECIFIED ELSEWHERE	
1	EA	WIRING ELEVATION AND POINT-TO-POINT WIRING DRAWINGS	AS REQUIRED	

ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
• DOOR IS NORMALLY CLOSED AND LOCKED.
• DOOR CAN BE UNLOCKED BY VALID CREDENTIAL. VALID CREDENTIAL WILL UNLOCK TRIM TO ALLOW ENTRY.
• REQUEST TO EXIT AND DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.
• KEY OVERRIDE FOR MECHANICAL ENTRY.
• FREE EGRESS ALWAYS ALLOWED.
• DOOR UNLOCKS UPON ACTIVATION OF FIRE ALARM.

HARDWARE GROUP NO. N40.1 - (SINGLE WITH FAIL SAFE ELECTRIFIED RIM FIRE EXIT HARDWARE X SMOKE GASKETING X CREDENTIAL READER)
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	RX-FSA-25-R-L 24 VDC	FAL
1	EA	RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURFACE CLOSER	SC71A SS	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	GASKETING	488S	ZER
1	EA	DOOR CONTACT	679-05HM/WD	SCE
1	EA	POWER SUPPLY	PS902 900-FA 120/240 VAC	VON
1	EA	CREDENTIAL READER	SPECIFIED ELSEWHERE	
1	EA	WIRING ELEVATION AND POINT-TO-POINT WIRING DRAWINGS	AS REQUIRED	

ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
• DOOR IS NORMALLY CLOSED AND LOCKED.
• DOOR CAN BE UNLOCKED BY VALID CREDENTIAL. VALID CREDENTIAL WILL UNLOCK TRIM TO ALLOW ENTRY.
• REQUEST TO EXIT AND DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.
• KEY OVERRIDE FOR MECHANICAL ENTRY.
• FREE EGRESS ALWAYS ALLOWED.
• DOOR UNLOCKS UPON ACTIVATION OF FIRE ALARM.

HARDWARE GROUP NO. N47 - (OVERHEAD COILING DOORS)
Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CYLINDER	AS REQUIRED	SCH
1		BALANCE OF HARDWARE	BY DOOR MANUFACTURER	

DOOR INDEX

Door Numbers	HwSet#
001	N12
002	N30
003	N27
004	N30.3
005	N38.3
006	N31
007	N27
008	N27
009	N27
010	N27
011	N27
012	N20
013	N20
100	N08
101	N20
102	N30.3
103	N20
105	N30.3
106A	N10
106C	N39
107	N27
108	N11
109A	N16
109B	N10
110	N20
111	N20
112	N20
113	N20
114	N12
115A	N47
115B	N47
115C	N47
115D	N47
200A	N37.1
200B	N38
201	N12
202	N14.3
202A	N11.1
204	N14.2
205	N30.3
206	N12.1
206A	N31.2

Door Numbers	HwSet#
07	N20
208	N20
209	N20
210	N20
211A	N30.2
211B	N28
212	N20
213	N20
214	N12.2
215	N20
216	N20
219	N12.2
220	N20
221	N20
222	N20
223	N20
224A	N19
224B	N17.1
225	N20
226	N20
227	N20
228	N20
229	N12.2
230	N20
231	N12
E014A	N47
E014B	N47
E016A	N47
E016B	N07
E100A	N02X
E100B	N01
ST001A	N40
ST001B	N40
ST002A	N38
ST002B	N07
ST101A	N40.1
ST101B	N40.1
ST102	N40
ST201	N40
ST202	N40

END OF SECTION

SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Glass and glazing for the following products and applications:

a. Steel doors, frames and sidelights specified in Section 081110 - HOLLOW METAL DOORS AND FRAMES.
b. Glazed entrances and storefronts specified in Section 084110 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
c. Interior lites.
d. Unframed mirrors.
e. Glazing film.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 081400 - FLUSH WOOD DOORS for factory glazing.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions.

Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Specified Design Wind Loads: As required by Code.
b. Specified Design Snow Loads for Sloped Glazing: As required by Code.
c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

d. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.

1) Load Duration: 30 days.

e. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

1) For monolithic-glass lites heat-treated to resist wind loads.
2) For insulating glass.
3) For laminated-glass lites.

f. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch-wide interspace.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 6.3 computer program for the following methodologies:

   a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
   b. Solar Heat Gain Coefficient: NFRC 200.
   c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: 12-inch- square Samples for each type of glass and glass assembly, glazing sealants.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

E. Qualification Data: For installers.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: For each type of glazing products:

H. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance..

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, laminated glass and insulating glass.

C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

F. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

G. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test, unless required by authorities having jurisdiction.

H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency] acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup for types of windows indicated, in locations shown on Drawings.

L. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to the Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to the Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INSULATING-GLASS UNITS

A. Insulating-Glass Units for Vertical Glazing: 1 inch thick (25.0 mm) insulating glass consisting of two lites of 1/4 inch (6 mm) glass, low e coating on the No. 2 surface and argon gas filled. Provide one of the following or equal:

1. Guardian Industries; SN-68.

a. Visible Light Transmittance: 68 percent.
b. Reflectance Visible Light: 10 percent.
c. U Value (Winter): 0.25.
d. Shading Coefficient: 0.43.
e. Solar Heat Gain Coefficient: 0.38.

2. Viracon; VE1-2M.

a. Visible Light Transmittance: 70 percent.
b. Reflectance Visible Light: 11 percent.
c. U Value (Winter): 0.25.
d. Shading Coefficient: 0.43.
e. Solar Heat Gain Coefficient: 0.37.

3. Vitro Architectural Glass (formerly PPG Industries); Solarban 60.

a. Visible Light Transmittance: 70 percent.
b. Reflectance Visible Light: 11 percent.
c. U Value (Winter): 0.29.
d. Shading Coefficient: 0.44.
e. Solar Heat Gain Coefficient: 0.38.

B. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

1. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

C. Coated Float Glass: Pyrolytic and vacuum deposited coatings on glass in conformance with ASTM C 1376.

D. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.

1. Tint Color: As selected by the Architect.
2. Visible Light Transmittance: As standard with manufacturer.

E. Tempered Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind FT; 1/4 inch thick unless indicated otherwise.

F. Patterned Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.

G. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction for Framed Units: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
2. Construction for Units with Exposed Edges: Laminate glass with cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
3. Interlayer Thickness: 0.030 inch (0.76 mm) thick for vertical glazing, 0.060 inch (1.52 mm) thick for sloped glazing.
4. Interlayer Color: Clear unless otherwise indicated.

H. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by an argon-filled interspace, and complying with ASTM E2190 and with requirements specified in this Section.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 “Performance Requirements” paragraph.
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit’s edge.
4. Sealing System: Dual seal, with primary and secondary sealants as follows:

    a. Manufacturer’s Standard Sealants. Butyl primary and silicone secondary sealants. Secondary sealant shall cover entire spacer bar at IGU perimeter.

5. Spacer Specifications: Manufacturer’s standard spacer material. Spacer corners shall be bent, soldered, or welded. Keyed spacer corners will not be accepted. Spacer may have a mid-span spacer key located at the midpoint of the insulating glass unit head. Where a mid-span spacer key is used, the key must be fully embedded (all sides) in butyl sealant.

I. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

1. Mirror Edge Treatment: Flat polished edge.

J. Glazing Film: Translucent, dimensionally stable, cast PVC film, 2-mil-minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.

1. Manufacturers: Subject to compliance with requirements, available manufacturer's that may be incorporated into the Work include, but are not limited to, the following:

a. Avery Dennison, Graphics.
b. FDC Graphic Films, Inc.
c. Madico, Inc.
d. 3M Scotchcal.

2. Comply with requirements for safety glazing.
3. Use: Suitable for exterior and interior applications.
4. Patterns: As selected by Architect from manufacturer's full range.

2.3 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Verify glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, interlayer of laminated glass, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
4. VOC Emissions: Provide sealants in compliance with the 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."
5. VOC Content:

a. Structural Glazing Adhesives: 100 g/L.
b. Architectural Sealants: 250 g/L.

6. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:

a. Dow Corning Corporation; 790.
b. GE Silicones; SilPruf LM SCS2700.

c. Tremco Inc.; Spectrem 1.

C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.4 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for project conditions.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

G. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. VOC Emissions: Provide adhesives in compliance with the 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. VOC Content: 250 g/L or less.
3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
4. Do not use adhesives that contain urea formaldehyde.

H. Mirror Hardware, Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

K. Glazing Film: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION

SECTION 090002

TILE

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 090002 - TILE

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-000 STANDARD NOTES, ABBREVIATIONS, TYP. PARTITION TYPES & MOUNTING HEIGHTS
A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-200 BASEMENT REFLECTED CEILING PLAN
A-201 FIRST FLOOR REFLECTED CEILING PLAN
A-202 SECOND FLOOR REFLECTED CEILING PLAN
A-610 ENLARGED TOILET ROOM DRAWINGS TOILETS 012, 013, 101 & 103

A-611 ENLARGED TOILET ROOM DRAWINGS TYPICAL DECON. SHOWERS & TOILET 230
A-612 ENLARGED DAY ROOM AND TYPICAL FIREFIGTHER SHOWER DRAWINGS
A-700 INTERIOR ELEVATIONS
A-701 INTERIOR ELEVATIONS
A-702 INTERIOR ELEVATIONS
A-900 ROOM FINISH SCHEDULE AND DETAILS
A-910 BASEMENT FINISH PLAN
A-911 FIRST FLOOR FINISH PLAN
A-912 SECOND FLOOR FINISH PLAN

1.2 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. All Work of Section 093000 - TILING

END OF SECTION

SECTION 090003

ACOUSTICAL TILE

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 090003 – ACOUSTICAL TILE

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-000 STANDARD NOTES, ABBREVIATIONS, TYP. PARTITION TYPES & MOUNTING HEIGHTS
A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-200 BASEMENT REFLECTED CEILING PLAN
A-201 FIRST FLOOR REFLECTED CEILING PLAN
A-202 SECOND FLOOR REFLECTED CEILING PLAN
A-400 BUILDING SECTIONS

A-401 BUILDING SECTIONS
A-402 BUILDING SECTIONS
A-403 BUILDING SECTIONS
A-500 WALL SECTIONS
A-501 WALL SECTIONS
A-502 WALL SECTIONS
A-503 WALL SECTIONS
A-520 SECTION DETAILS
A-521 SECTION DETAILS
A-522 SECTION DETAILS
A-523 SECTION DETAILS
A-900 ROOM FINISH SCHEDULE AND DETAILS
A-910 BASEMENT FINISH PLAN
A-911 FIRST FLOOR FINISH PLAN
A-912 SECOND FLOOR FINISH PLAN

1.2 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. All Work of Section 095100 - ACOUSTICAL CEILINGS

END OF SECTION

SECTION 090005

RESILIENT FLOORS

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 090005 – RESILIENT FLOORS

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-000 STANDARD NOTES, ABBREVIATIONS, TYP. PARTITION TYPES & MOUNTING HEIGHTS
A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-900 ROOM FINISH SCHEDULE AND DETAILS
A-910 BASEMENT FINISH PLAN
A-911 FIRST FLOOR FINISH PLAN
A-912 SECOND FLOOR FINISH PLAN

1.2 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. All Work of Section 096510 - RESILIENT FLOORING AND ACCESSORIES

END OF SECTION

SECTION 090007

PAINTING

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 090007 – PAINTING

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-000 STANDARD NOTES, ABBREVIATIONS, TYP. PARTITION TYPES & MOUNTING HEIGHTS
AD-010 SITE DEMOLITION PLAN
AD-100 BASEMENT DEMOLITION PLAN
AD-101 FIRST FLOOR DEMOLITION PLAN
AD-102 SECOND FLOOR DEMOLITION PLAN
A-010 SITE PLAN
A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN

A-102 SECOND FLOOR PLAN
A-110 ROOF PLAN
A-200 BASEMENT REFLECTED CEILING PLAN
A-201 FIRST FLOOR REFLECTED CEILING PLAN
A-202 SECOND FLOOR REFLECTED CEILING PLAN
A-300 EXTERIOR ELEVATIONS
A-301 EXTERIOR ELEVATIONS
A-302 PROPOSED 3D VIEWS
A-400 BUILDING SECTIONS
A-401 BUILDING SECTIONS
A-402 BUILDING SECTIONS
A-403 BUILDING SECTIONS
A-600 ELEVATOR DRAWINGS
A-601 ENLARGED STAIR 2 DRAWINGS
A-602 ENLARGED STAIR 3 DRAWINGS
A-603 EXTERIOR STAIR AND RAMP DRAWINGS
A-610 ENLARGED TOILET ROOM DRAWINGS TOILETS 012, 013, 101 & 103
A-611 ENLARGED TOILET ROOM DRAWINGS TYPICAL DECON. SHOWERS & TOILET 230
A-612 ENLARGED DAY ROOM AND TYPICAL FIREFIGTHER SHOWER DRAWINGS
A-700 INTERIOR ELEVATIONS
A-701 INTERIOR ELEVATIONS
A-702 INTERIOR ELEVATIONS
A-800 DOOR SCHEDULE AND DETAILS
A-801 DOOR DETAILS
A-802 DOOR DETAILS
A-900 ROOM FINISH SCHEDULE AND DETAILS
A-910 BASEMENT FINISH PLAN
A-911 FIRST FLOOR FINISH PLAN
A-912 SECOND FLOOR FINISH PLAN

1.2 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. All Work of Section 099000 - PAINTING AND COATING

END OF SECTION

SECTION 092110

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Interior gypsum wallboard.
2. Tile backing panels.
3. Acoustic insulation (sound attenuation batts) in gypsum wallboard assemblies.
4. Non-load-bearing steel framing.
5. Installation of access panels.
6. Marking and identification for fire- and smoke-partitions.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 054000 - COLD-FORMED METAL FRAMING for load-bearing steel framing.
2. Section 061000 - ROUGH CARPENTRY for plywood blocking and backing panels.
3. Section 061600 - SHEATHING for gypsum sheathing at exterior assemblies.
4. Section 083110 - ACCESS DOORS AND FRAMES for installation in gypsum board assemblies.
5. Section 092120 - GYPSUM BOARD SHAFT WALL ASSEMBLIES for framing, gypsum panels, other components of shaft wall assemblies, and finishing gypsum board shaft wall assemblies.
6. Section 093000 - TILING for joint compound and tape at cementitious tile backing panels.
7. Section 095100 - ACOUSTICAL CEILINGS for suspension systems for acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide fire stop tracks capable of withstanding deflection within limits and under conditions indicated.

1. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.

B. Marking and Identification for Fire- and Smoke-Partitions: Fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions and other walls required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:

1. Be located in accessible concealed floor, floor-ceiling or attic spaces; and
2. Locate within 15 feet of end of each wall and repeat at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
3. Include lettering not less than 3 inches in height with a minimum 3/8 inch stroke in contrasting color, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," or other wording.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: If materials and systems other than those specified and those indicated on the Drawings are proposed for use, submit shop drawings signed and sealed by a structural engineer licensed in the jurisdiction of the project certifying proposed systems meet code requirements, project requirements and the following deflection criteria:

1. For gypsum board assemblies without applied rigid finishes L/240; for gypsum board assemblies with applied rigid finishes such as tile, stone, wood paneling L/360. Lateral load 5 psf except at shafts. Lateral load at shafts shall be required based on analysis of equipment and systems using shaft.

C. Samples: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.5 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for each level of gypsum board finish indicated for use in exposed locations, including textures if applicable.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

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.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: Manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.
3. Recycled Content: Use minimum recycled content of 25%.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, expansion anchor.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges with depth as required for span and loading and indicated on Drawings.

E. Furring Channels (Furring Members): 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    b. Rockfon; Chicago Metallic Drywall Grid.
    c. USG Corporation; Drywall Suspension System.

2. Performance Requirements: Ceiling support system shall support a live load of 6 psf minimum at L/240.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. California Expanded Metals Co. (CEMCO).
2. ClarkDietrich.
3. Marino\WARE.
4. The Steel Network (TSN).

B. Steel Studs and Runners: ASTM C 645.

1. Sustainable Design Requirements:

    a. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
    b. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD).

2. Minimum Base-Steel (Uncoated) Thickness: 0.0296 inches (20 gage).
3. Dimpled studs meeting performance values for equivalent standard studs are acceptable.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

    a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

        1) Brady Innovations; Sliptrack Systems.
        2) California Expanded Metals Co. (CEMCO); CST Slotted Tracks.
        3) Clark Dietrich Building Systems; MaxTrak Slotted Deflection Track.
        4) Steel Network Inc. (The); VertiTrack VT Series.

D. Fire Stop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness compatible with studs and in width to accommodate depth of studs.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. California Expanded Metals Co. (CEMCO); FAS-TRK 1000 Slotted Tracks.
b. Clark Dietrich Building Systems; BlazeFrame Fire Stop Deflection Track.
c. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0312 inch (20 gauge).

F. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0312 inch (20 gauge).
2. Depth: 7/8 inches.

H. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission. Strictly comply with manufacturer's installation instruction.

1. Basis of Design: ClarkDietrich; RC Deluxe, asymmetrical configuration.

I. Resilient Sound Isolation Clips: Galvanized steel and resilient material sound-isolation clips.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Kinetics Noise Control Co.; IsoMax.
b. PAC International, Inc.; RSIC-1.
c. Pliteq, Inc.; GenieClip.
d. Studco Building Systems; Resilmount A237R.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

K. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

L. Isolation Strip at Exterior Walls: Adhesive-backed, closed-cell foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

2.4 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Gypsum, Inc.
2. National Gypsum Company.
3. United States Gypsum Company (USG).

B. Gypsum Wallboard: ASTM C 1396.

1. Basis of Design: USG; SHEETROCK EcoSmart Panels.

a. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
b. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2. Thickness: 1/2 inch and 5/8 inch as indicated.
3. Long Edges: Tapered.

C. Gypsum Wallboard, Fire-Resistant Type X: ASTM C 1396.

1. Basis of Design: USG; SHEETROCK EcoSmart Panels Firecode X.

a. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
b. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
c. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.

1. Basis of Design: USG; SHEETROCK EcoSmart Mold Tough Firecode X.

a. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
b. Building Product Disclosure and Optimization, Material Ingredients: Declare product labels.
c. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TILE BACKING PANELS

A. Cementitious Tile Backing Panels: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Custom Building Products; Wonderboard and Wonderboard Lite.
b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
c. National Gypsum Company; PermaBASE and PermaBASE Plus Cement Board.
d. USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
4. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. Expansion (control) joint.
e. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backing Panels: Refer to Section 093000 - TILING for thinset, nonsag mortar, as recommended by backing panel manufacturer.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Basis of Design: Henkel; OSI F38 Drywall and Panel Adhesive.
2. Low-Emitting Materials: Provide adhesives in compliance with the 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."
3. VOC Content: 50 g/L or less.
4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
5. Do not use adhesives that contain urea formaldehyde.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious tile backing panels, use screws of type and size recommended by panel manufacturer.

D. Acoustic Insulation, Sound Attenuation (Batts) Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Knauf Insulation; EcoBatt.
b. Owens Corning; PINK Next Gen Fiberglass Sound Attenuation Batts (SAB).
c. Owens Corning; Thermafiber SAFB FF.
d. Rockwool (formerly Roxul); AFB evo.

2. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD).
3. Recycled Content: 65 percent minimum.
4. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
5. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification, formaldehyde-free.
6. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, joint sealant, recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Available Products, for Concealed and Exposed Joints: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
    b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
    c. USG; SHEETROCK Acoustical Sealant.

2. Available Products, for Concealed Joints Only: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. OSI (a division of Henkel); Pro-Series SC-175.
    b. Pecora Corp.; BA-98.
    c. Tremco, Inc.; Tremco Acoustical/Curtainwall Sealant.

3. Low-Emitting Materials: Provide sealants in compliance with the 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."
4. VOC Content, Architectural Sealants: 250 g/L or less.
5. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

2.9 IDENTIFICATION LABELS FOR FIRE- AND SMOKE-PARTITIONS

A. Identification Labels: Self-adhesive signs, to comply with applicable local Code.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fire Wall Signs, Inc.
    b. Marking & Identification Tape (mnitape.com).
    c. My Safety Sign.
    d. Safety Supply Warehouse.

2. Text: "FIRE AND SMOKE BARRIER - PROTECT ALL OPENINGS".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754. Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

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 sys

tem 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. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. 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.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks (runners) 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 penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on doorframes; install runner 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 1/2-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. 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.
6. Curved Partitions:

a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.

D. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Furring Members:

1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.6 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (including above ceilings), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.7 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels to minimize end joints.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.8 APPLYING TILE BACKING PANELS

A. Cementitious Tile Backing Panels: ANSI A108.1, at locations indicated to receive tile.

1. Refer to Section 093000 - TILING for joint treatment.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.9 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.10 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas and concealed areas not exposed to view.
2. Level 2: Gypsum panels that are substrate for tile.
3. Level 3: Not Used.
4. Level 4: Panel surfaces that will be exposed to view (typical panels).
5. Level 5: Where indicated on Drawings.

E. Cementitious Tile Backing Panels: Refer to Section 093000 - TILING for tape and mortar application at joints.

3.11 INSTALLING IDENTIFICATION FOR FIRE- AND SMOKE-PARTITIONS

A. Marking and Identification for Fire- and Smoke-Partitions: Permanently install as required by Code.

3.12 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or exhibit mold growth. Repair of damaged panels in place is not acceptable.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 092120

GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Gypsum board shaft wall assemblies.
2. Marking and identification for fire- and smoke-partitions.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 083110 - ACCESS DOORS AND FRAMES for installation in gypsum board assemblies.
2. Section 092110 - GYPSUM BOARD ASSEMBLIES for non-shaft-wall gypsum board assemblies.
3. Section 092110 - GYPSUM BOARD ASSEMBLIES for applying and finishing panels in gypsum board assemblies.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board construction not defined in this Section or in other referenced standards.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance:

1. Provide gypsum board shaft wall assemblies capable of withstanding the full air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.
2. Provide gypsum board shaft wall assemblies for horizontal duct enclosures capable of spanning distances indicated within deflection limits indicated.

B. Marking and Identification for Fire- and Smoke-Partitions: Fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions and other walls required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:

1. Be located in accessible concealed floor, floor-ceiling or attic spaces; and
2. Locate within 15 feet of end of each wall and repeat at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
3. Include lettering not less than 3 inches in height with a minimum 3/8 inch stroke in contrasting color, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," or other wording.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Fire-Test-Response Reports: From a qualified independent testing and inspecting agency substantiating each gypsum board shaft wall assembly's required fire-resistance rating.

1. Include data substantiating that elevator entrances and other items that penetrate each gypsum board shaft wall assembly do not negate fire-resistance rating.

1.6 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products," UL's "Fire Resistance Directory," or ITS's "Directory of Listed Products."

B. STC-Rated Assemblies: For gypsum board shaft wall assemblies indicated to have STC ratings, provide assembly materials and construction complying with requirements of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01. Review methods and procedures for installing work related to gypsum board shaft wall assemblies including, but not limited to, the following:

1. Fasteners proposed for anchoring steel framing to building structure.
2. Sprayed fire-resistive materials applied to structural framing.
3. Elevator equipment, including hoistway doors, elevator call buttons, and elevator floor indicators.
4. Wiring devices in shaft wall assemblies.
5. Doors and other items penetrating shaft wall assemblies.
6. Items supported by shaft wall-assembly framing.
7. Mechanical work enclosed within shaft wall assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat on leveled supports off the ground to prevent sagging.

1.8 PROJECT CONDITIONS

A. Comply with requirements for environmental conditions, room temperatures, and ventilation specified in Section 092110 - GYPSUM BOARD ASSEMBLIES.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Gypsum, Inc.
2. National Gypsum Company.
3. United States Gypsum Company (USG).

2.2 ASSEMBLY MATERIALS

A. General: Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.

1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
2. Provide auxiliary materials complying with gypsum board shaft wall assembly manufacturer's written recommendations.

B. Steel Framing: ASTM C 645.

1. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized coating.

C. Gypsum Liner Panels: Manufacturer's proprietary liner panels in 1-inch thickness and with moisture-resistant paper faces.

D. Gypsum Wallboard: ASTM C 1396, core type as required by fire-resistance-rated assembly indicated.

E. Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Section 092110 - GYPSUM BOARD ASSEMBLIES comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.

F. Gypsum Wallboard Joint-Treatment Materials: ASTM C 475 and as specified in Section 092110 - GYPSUM BOARD ASSEMBLIES.

G. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

H. Track (Runner) Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Powder-Actuated Fasteners: Provide powder-actuated fasteners with capability to sustain, without failure, a load equal to 10 times that imposed by shaft wall assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 1190.

2. Postinstalled Expansion Anchors: Where indicated, provide expansion anchors with capability to sustain, without failure, a load equal to 5 times that imposed by shaft wall assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

I. Laminating Adhesive: Comply with requirements of Section 092110 - GYPSUM BOARD ASSEMBLIES.

J. Acoustic Insulation, Sound Attenuation (Batts) Blankets: Comply with requirements of Section 092110 - GYPSUM BOARD ASSEMBLIES.

K. Acoustical Sealant: Comply with requirements of Section 092110 - GYPSUM BOARD ASSEMBLIES.

2.3 GYPSUM BOARD SHAFT WALL

A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing and inspecting agency.

B. Sustained Air-Pressure Loads: 5 lbf/sq. ft.

C. Deflection Limit: L/240.

D. Studs: Manufacturer's standard profile for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.

1. Depth: As indicated.
2. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.

E. Track (Runner): Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches in depth matching studs.

1. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.

F. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches, in depth matching studs, and not less than 0.0341 inch thick.

G. Room-Side and Shaft-Side Finish: As indicated.

H. STC Rating: As indicated.

I. Cavity Insulation: Sound attenuation blankets.

2.4 IDENTIFICATION LABELS FOR FIRE- AND SMOKE-PARTITIONS

A. Identification Labels: Self-adhesive signs, to comply with applicable local Code.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire Wall Signs, Inc.

b. Marking & Identification Tape.
c. My Safety Sign.
d. Safety Supply Warehouse.

2. Text: "FIRE AND SMOKE BARRIER-PROTECT ALL OPENINGS"

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway doorframes, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:

1. ASTM C 754 for installing steel framing and gypsum shaft wallboard.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft wall assembly framing.

1. At elevator hoistway doorframes, provide jamb struts on each side of doorframe.
2. Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 face-layer panel.

D. Integrate stair hanger rods with gypsum board shaft wall assemblies by locating cavity of assemblies where required to enclose rods.

E. At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

F. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.

G. Install control joints to maintain fire-resistance rating of assemblies.

H. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.

3.4 FINISHING GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas and concealed areas not exposed to view.
2. Level 2: Panels that are substrate for tile.
3. Level 4: Panel surfaces that will be exposed to view (typical panels).
4. Level 5: Where indicated on Drawings.

3.5 INSTALLING IDENTIFICATION FOR FIRE- AND SMOKE-PARTITIONS

A. Marking and Identification for Fire- and Smoke-Partitions: Permanently install as required by Code.

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or exhibit mold growth. Repair of damaged panels in place is not acceptable.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 093000

TILING

(PART OF WORK OF SECTION 090002 - TILE, FILED SUB-BID REQUIRED)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Floor, wall, and base tiles.
2. Furnish floor tile for installation in electric traction elevators.
3. Setting materials and accessories.
4. Surface preparation.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 079200 - JOINT SEALANTS for sealing of movement joints in tile surfaces.
2. Section 083110 - ACCESS DOORS AND FRAMES for installation in tile.
3. Section 092110 - GYPSUM BOARD ASSEMBLIES for tile backing panels.

1.3 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge 15 inches or longer.

D. Module Size: Actual tile size plus joint width indicated.

1.4 PERFORMANCE REQUIREMENTS

A. Wet Dynamic Coefficient of Friction: For flooring exposed as a walking surface, provide products with the following values as determined by testing identical products per ANSI/ NFSI B101.3 - 2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials, or ANSI 326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials - 2017. Testing by other methods or earlier editions of the specified test method is not acceptable.

1. Wet Dynamic Coefficient of Friction: Not less than 0.43.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces.

1. For feature spaces including lobbies, reception areas, corridors, and similar, include layout drawings based on field measurements.

C. Samples for Verification:

1. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed work.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone Thresholds: 6-inch lengths.
4. Metal Edge Strips: 6-inch lengths.

D. Qualification Data: For Installer.

E. Product Test Reports: For each tile setting product.

1. Tile-setting and -grouting products.
2. Certified porcelain tile.
3. Slip-resistance test reports from qualified independent testing agency.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting Materials: Obtain ingredients of a uniform quality for each membrane, mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

1. Stone thresholds.
2. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1. Review requirements in ANSI A108.01 for substrate flatness and for preparation by other trades.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid additives in unopened containers and protected from freezing.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 WARRANTY

A. Tiling Contractor’s Warranty: The tiling subcontractor shall supply Owner with a minimum two-year workmanship warranty for each tile area. In the event any work related to the tiling and setting materials is found to be defective within two years of substantial completion, the tiling contractor shall remove and replace such at no additional cost to the Owner. The tiling subcontractor’s warranty obligation shall run directly to the Owner, and a copy the tiling signed warranty shall be sent to the tiling system’s manufacturer.

1. The duration of the tiling subcontractor’s two-year warranty shall run concurrent with the tiling system’s manufacturer’s 25-year warranty.

B. Tiling Systems Manufacturer’s Warranty: The tiling systems manufacturer shall guarantee installed tile areas to be in a fully bonded, uncracked, flat, and watertight condition, for a period of 25 years, from the date of final acceptance of the tiling system. The warranty shall be a 25-year no dollar limit (NDL), non-prorated total system labor and material warranty. Total system warranty shall include tiling materials, related components and accessories including, but not limited to the substrate board, waterproofing and crack isolation membranes, mortars, grouts, adhesives, transition materials, and floor drain assemblies.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
2. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD for ceramic tiles.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Tile Types: Refer to Finish Schedule.

B. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

C. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

D. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes selected from manufacturer's standard shapes.

2.3 THRESHOLDS AND EDGE STRIPS

A. Thresholds: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

C. Metal Edge Strips and Flooring Transitions: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and resilient base, designed specifically for flooring applications.

1. Basis of Design: Schluter Systems.
2. Material: ASTM B 221, extruded aluminum, with clear anodized satin finish.

2.4 SETTING MATERIALS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Custom Building Products.
2. Laticrete International, Inc.
3. MAPEI Corporation.

B. Trowelable Underlayments and Patching Compounds, for Concrete Substrates: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

C. Waterproofing and Crack Isolation Membrane: Manufacturer's standard product, that complies with ANSI A118.10 and ANSI A118.12 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

D. Fabric-Reinforced, Fluid-Applied Waterproofing and Crack Isolation Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
    b. Laticrete; Hydro Ban.
    c. MAPEI; Mapelastic AquaDefense.

2. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
3. Low-Emitting Materials, General Emissions Evaluation: Provide membranes in compliance with the 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."

    a. VOC Content, Waterproofing Sealer: 100 g/L or less.
    b. GreenGuard Gold certification.

E. Modified Dry-Set (formerly Latex-Portland Cement) Mortar (Thinset): ANSI A118.4.

1. For Exterior Glue Plywood (EGP) Modified Dry-Set Mortar, comply with ANSI A118.11.
2. For Large and Heavy Tile, Improved Modified Dry-Set Mortars, comply with ANSI A118.15.
3. Provide prepackaged, dry-mortar mix containing dry, redispersible, acrylic additive to which only water must be added at Project site.
4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.
5. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD for mortar.

F. Medium-Bed, Latex-Portland Cement Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:

1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.
2. Prepackaged dry-mortar mix combined with liquid-latex additive.
3. Product: Laticrete 220 Medium Bed Mortar with 333 Superflex, or approved equal.

G. Mesh Tape for Tile Backing Panels: Alkali-resistant type, as recommended by panel manufacturer.

H. Tile Grout, Cementitious Type: ANSI A118.7, liquid-latex form for addition to prepackaged dry-grout mix.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Custom Building Products; Polyblend.
    b. Laticrete; Permacolor Select.

c. MAPEI; Keracolor.

2. Cementitious Grout Types:

a. Unsanded grout mixture for joints 1/8 inch and narrower.
b. Sanded grout mixture for joints 1/8 inch and wider.

3. Color: To be selected by Architect from manufacturer's full range.
4. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD for grout.
5. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
6. Low-Emitting Materials, General Emissions Evaluation: Provide membranes in compliance with the 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."

a. VOC Content, Ceramic, Glass, Porcelain, and Stone Tile Adhesives: 65 g/L or less.
b. GreenGuard Gold certification.

I. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

J. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

1. Low-Emitting Materials, General Emissions Evaluation: Provide membranes in compliance with the 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."

a. VOC Content, Tile and Stone Sealers: 100 g/L or less.
b. GreenGuard Gold certification.

2.5 ELASTOMERIC SEALANTS

A. Joint Sealants: Refer to Section 079200 - JOINT SEALANTS.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

2.6 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

D. Cementitious Tile Backing Panels: Treat joints to comply with ANSI A108.11.

E. Substrate Flatness:

1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

F. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILING INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. Membrane Installation:

1. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
2. Install crack-isolation membrane to comply ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
3. Do not install tile over membrane until membrane has cured and been tested to determine that it is watertight.

C. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. Follow procedures in ANSI A108 series of tile installation standards for providing minimum percent levels of mortar coverage.
2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

E. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. Expansion (Movement) Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 - JOINT SEALANTS.

G. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in mortar (thinset).
2. Do not extend membranes under thresholds set in mortar. Fill joints between such thresholds and adjoining tile set on membrane with elastomeric sealant.

H. Metal Edge Strips and Flooring Transitions: Install at locations indicated and where exposed edge of tile flooring meets other flooring that finishes flush with top of tile and no threshold is indicated.

I. Floor Sealer: Apply floor sealer to grout joints according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 CLEANING AND PROTECTING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

C. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed. After seven days, cover areas subject to construction traffic with heavy cardboard.

E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.5 TILE INSTALLATION SCHEDULE

A. This schedule refers to Tile Installation Methods specified in the TCNA Handbook.

B. Floor Tile Over Slab on Grade Concrete, Typical: TCNA F113 and ANSI A108.5.

1. Tile Type: Refer to Finish Schedule.
2. Mortar: Thinset.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/8 inch.
5. Crack isolation membrane, at large format tile.

C. Floor Tile Over Elevated Slab Concrete, at Toilet Rooms: TCNA F122 and ANSI A108.5.

1. Tile Type: Refer to Finish Schedule.
2. Mortar: Thinset.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/8 inch.
5. Waterproofing membrane.

D. Wall Tile, Typical Over Cementitious Tile Backing Panels: TCNA W244C and ANSI A108.5.

1. Tile Type: Refer to Finish Schedule.
2. Mortar: Thinset.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/16 inch.

E. Wall Tile Over Cementitious Tile Backing Panels, at Bathtubs and Showers: TCNA B420 and ANSI A108.5.

1. Tile Type: Refer to Finish Schedule.
2. Mortar: Thinset.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/16 inch.
5. Waterproofing membrane.

END OF SECTION

SECTION 095100

ACOUSTICAL CEILINGS

(Part of Work of Section 090003 - ACOUSTICAL TILE, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Acoustical ceiling tiles and panels.
2. Suspension systems, grid systems and ceiling hangers.
3. Acoustical sealant at edge moldings at acoustical ceilings.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 092110 - GYPSUM BOARD ASSEMBLIES for gypsum board ceilings and soffits, including suspension systems.
2. Division 21 - FIRE SUPPRESSION for fire-suppression components located in ceilings.
3. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for air handling and distribution components located in ceilings.
4. Division 26 - ELECTRICAL for light fixture and alarm system components located in ceilings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension members.
2. Method of attaching hangers to building structure. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/4 inch = 1 foot.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6 inch square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch long Samples of each type, finish, and color.

D. Asbestos Certification: Manufacturer's written certification that acoustical ceiling products contain no asbestos (0.0000%). Product labels indicating that it is the user's responsibility to test the products for asbestos are unacceptable and sufficient cause for rejection of the product on site.

E. Maintenance Data: For finishes to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panels: Obtain each type through one source from a single manufacturer.
2. Suspension Systems: Obtain each type through one source from a single manufacturer.
3. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
3. Identify materials with appropriate markings of applicable testing and inspecting agency.
4. Surface-Burning Characteristics: Provide acoustical panels complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

C. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

A. Basis-of-Design Products: Armstrong Ceilings.

1. AC-1: Ultima High NRC:

a. Panel Size: 24 inches by 24 inches by 7/8 inch.
b. Panel Mounting: Revealed edge.
c. Noise Reduction Coefficient (NRC): Not less than 0.80.
d. Ceiling Attenuation Class (CAC): Not less than 35.
e. Color: White.
f. Grid Material: Painted steel.
g. Grid Face Width: 15/16 inch.

2. AC-2: Ceramaguard:

a. Panel Size: 24 inches by 24 inches by 5/8 inch.
b. Panel Mounting: Square edge.
c. Noise Reduction Coefficient (NRC): Not less than 0.55.
d. Ceiling Attenuation Class (CAC): Not less than 38.
e. Color: White.
f. Grid Material: Painted aluminum.
g. Grid Face Width: 15/16 inch.

3. AC-3: Metalworks, Linear-Synchro Exterior:

a. Panel Size: 6 inches by 96 inches by 1 inch.
b. Type: Unperforated.
c. Color: Gun Metal.
d. Grid Material: Aluminum, mill finish.
e. Main Beam: 144 inches by 1-3/4 inches by 2-3/4 inches.
f. Cross Tee: 24 inches by 1-1/2 inches by 1-1/2 inches.

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong Ceilings.
2. CertainTeed Ceilings.
3. USG.

B. Sustainable Design Performance Requirements:

1. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
2. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
3. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2.3 METAL SUSPENSION SYSTEMS

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Color: White, prefinished.
6. Grid Face Width: As specified with ACT type.
7. Recycled Content: Use minimum recycled content of 25%.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Anchors in Concrete: Anchors with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency; zinc-plated for Class SC1 service.

a. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

a. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 diameter wire.

D. Hold-Down Clips: At vestibules and areas subject to wind uplift, provide manufacturer's standard hold-down clips spaced 24 inches on all cross tees.

2.4 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

B. Suspension Trim: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.; Axiom.
2. CertainTeed Ceilings; Approved equal.
3. USG Interiors, Inc.; Compasso.

2.5 ACOUSTICAL SEALANT

A. Acoustical Sealant, for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, joint sealant, recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. OSI (a division of Henkel); Pro-Series SC-175.
b. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
c. Pecora Corp.; BA-98.
d. Specified Technologies, Inc. (STI); Smoke N Sound Acoustical Sealant.
e. USG; SHEETROCK Acoustical Sealant.

2. Low-Emitting Materials: Provide adhesives and sealants in compliance with the 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."
3. VOC Content, Architectural Sealants: 250 g/L or less.
4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. Do not attach hangers to steel deck tabs.
7. Space hangers not more than 48 o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
2. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096510

RESILIENT FLOORING AND ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Resilient flooring.
2. Resilient wall base and accessories.
3. Resilient stair accessories.
4. Substrate preparation for resilient flooring and accessories.
5. High-performance adhesive suitable for RH and pH measured in substrate.

1.3 PERFORMANCE REQUIREMENTS

A. Wet Dynamic Coefficient of Friction: For flooring exposed as a walking surface, provide products with the following values as determined by testing identical products per ANSI/ NFSI B101.3 - 2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials, or ANSI 326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials - 2017. Testing by other methods or earlier editions of the specified test method is not acceptable.

1. Wet Dynamic Coefficient of Friction: Not less than 0.43.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Verification: Full-size units of each color and pattern of resilient flooring required.

1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.
2. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

D. Seam Samples for Sheet Flooring: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch. Sample applied to a rigid backing and prepared by Installer for this Project.

E. Maintenance Data: For resilient products to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.7 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 LINOLEUM SHEET FLOOR COVERING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. Forbo Flooring, Inc.
3. Tarkett Inc.

B. Linoleum Sheet Flooring: ASTM F 2034, Type I, linoleum sheet with backing.

1. Thickness: 0.18 inch.
2. Sheet Width: 78 inches.
3. Seaming Method: Welded.
4. Style and Colors: As indicated on the Finish Schedule.
5. Material Ingredients: Cradle to Cradle (C2C) certification or Declare product label. PVC, phthalate-, chlorine-, and halogen-free.
6. Low-Emitting Materials: FloorScore certification.

2.3 RUBBER ATHLETIC FLOORING

A. Basis of Design: EcoSurfaces; ECOfit.

1. Thickness: 8.2 mm.
2. Roll Size: 48 inches by 25 feet.
3. Color: To be selected by Architect from Manufacturer's full range.
4. Performance:

    a. Recovery after Static Load, ASTM F970: 0.004 inches.
    b. Coefficient of Friction, ASTM D2047: Greater than 0.8.
    c. FloorScore certified.
    d. Abrasion Resistance, ASTM D3389: Pass.
    e. Flammability, ASTM D2859: Pass.
    f. Delta Impact Isolation Class (IIC), ASTM E2179: 24.

2.4 LUXURY VINYL TILE FLOOR COVERING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. Congoleum Corporation.
3. Mannington Mills, Inc.
4. Tarkett, Inc.

B. Luxury Vinyl Tile Floor Covering: ASTM F 1700.

1. Thickness: Minimum 0.080 inch.
2. Size: As indicated on the Finish Schedule.
3. Style and Colors: As indicated on the Finish Schedule.

2.5 RUBBER FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Biltrite Flooring; AB Pure.
2. Johnsonite, a division of Tarkett.
3. Nora Systems, Inc.

B. Rubber Floor Tile: ASTM F 1344, Class 1, A or B (Rubber Tile).

1. Thickness: 0.125 inch.
2. Size: 24 by 24 inches nominal.
3. Style and Colors: As indicated on the Finish Schedule.

4. Material Ingredients: Cradle to Cradle (C2C) certification or Declare product label. PVC, phthalate-, chlorine-, and halogen-free.
5. Low-Emitting Materials: FloorScore certification.

2.6 RESILIENT WALL BASE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Biltrite Flooring; AB Pure.
2. Johnsonite, a division of Tarkett.
3. Nora Systems, Inc.

B. Resilient Wall Base: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous). Do not use polyvinyl chloride (PVC).

1. Shape: Straight (toeless) at carpet and coved at concrete and resilient flooring.
2. Minimum Thickness: 0.125 inch.
3. Height: 4 inches.
4. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
5. Outside Corners: Premolded.
6. Inside Corners: Premolded.
7. Surface: Smooth.
8. Style and Colors: To be selected by Architect from Manufacturer’s full range.
9. Material Ingredients: Cradle to Cradle (C2C) certification or Declare product label. PVC, phthalate-, chlorine-, and halogen-free.
10. Low-Emitting Materials: FloorScore certification.

2.7 RESILIENT STAIR ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Biltrite Flooring; AB Pure.
2. Johnsonite, a division of Tarkett.
3. Nora Systems, Inc.

B. Resilient Treads and Risers: ASTM F 2169, Rubber, Composition A.

1. Size: Lengths and depths to fit each stair tread in one piece.
2. Style and Colors: As indicated on the Finish Schedule.

C. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

2.8 RESILIENT MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Biltrite Flooring; AB Pure.
2. Johnsonite, a division of Tarkett.
3. Nora Systems, Inc.

B. Types Include the Following as Applicable: Cap for cove carpet, cap for cove resilient sheet floor covering, carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet.

1. Material: Rubber.
2. Profile and Dimensions: As indicated.

2.9 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.

1. Available Products: Mapei; Mapecem Premix.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Low-Emitting Materials: Provide adhesives in compliance with the 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."

a. VOC Content: 50 g/L or less.
b. Methylene chloride and perchloroethylene may not be intentionally added to adhesives. Do not use adhesives that contain urea formaldehyde.

2. Adhesives, for Wall Base:

a. Available Products: Subject to compliance with requirements, provide one of the following products:

1) Forbo; L910W Wall Adhesive.
2) Johnsonite; 960 Cove Base Adhesive.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

a. Color: Match floor covering.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within a range on pH scale not less than 5 or more than 9 pH, or as otherwise required in writing by manufacturer of flooring.
3. Moisture Vapor Emission Testing:

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, or as otherwise required in writing by manufacturer of flooring.

4. Relative Humidity Testing:

    a. Perform relative humidity test, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level of 75 percent, or as otherwise required in writing by manufacturer of flooring.

5. Perform tests indicated above and as recommended by flooring manufacturer. Proceed with installation only after substrates pass testing.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

1. Slope floor where indicated on Drawings.

E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SHEET INSTALLATION

A. Comply with manufacturer's written instructions for installing floor coverings.

B. Unroll floor coverings and allow them to stabilize before cutting and fitting.

C. Lay out floor coverings as follows:

1. Maintain uniformity of floor covering direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.

H. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

J. Integral-Flash-Cove Base: Cove floor coverings up vertical surfaces as indicated on Drawings. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.

3.4 TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, doorframes, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Premolded Corners: Install premolded corners before installing straight pieces.

3.6 RESILIENT ACCESSORY INSTALLATION

A. Resilient Stair Accessories:

1. Tightly adhere to substrates throughout length of each piece.
2. For treads installed as separate, equal-length units, install to produce a flush joint between units.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.7 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.

3. Damp-mop surfaces to remove marks and soil.

    a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not apply protective floor polish.
2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

SECTION 096710

RESINOUS FLOORING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Resinous flooring systems.

B. Alternates: Not Applicable.

C. Items To Be Installed Only: Not Applicable.

D. Items To Be Furnished Only: Not Applicable.

E. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 079200 - JOINT SEALANTS for sealants installed at joints in resinous flooring systems.

1.3 PERFORMANCE REQUIREMENTS

A. Chemical Resistance:

1. Request from the Owner detailed information for these agents including concentration utilized and frequency of application for each.
2. Certify in writing to the Owner and Architect that resinous flooring systems can resist repeated exposure to these agents.

B. Wet Dynamic Coefficient of Friction: For flooring exposed as a walking surface, provide products with the following values as determined by testing identical products per ANSI/ NFSI B101.3 - 2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials, or ANSI 326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials - 2017. Testing by other methods or earlier editions of the specified test method is not acceptable.

1. Wet Dynamic Coefficient of Friction: Not less than 0.43.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Shop Drawings: Provide floor plans, to scale matching Architectural Plans, which indicate extent of each different resinous flooring system including system type, color and pattern, degree of slip resistance, and dimensioned locations of control joints and seams where systems meet.

1. Provide enlarged details, at minimum 3 inch = 1 foot scale, indicating conditions at walls, door frames, pits, curbs, equipment pedestals, etc.

C. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

D. Material Certificates: For each resinous flooring component, signed by manufacturer.

E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

F. Maintenance Data: For resinous flooring to include in maintenance manuals.

G. Test Results: For field testing of substrate, signed by installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems 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, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for applying resinous flooring systems indicated.
2. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch- square floor area selected by Design Professional.

a. Include 48-inch length of integral cove base.

2. Simulate finished lighting conditions for Design Professional's review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Pre-installation Conference: Prior to installation of flooring, meet at the Project site with the Manufacturer's Representative, Installer, Architect, and Owner. Record discussions and furnish copy to each participant. Topics to be discussed shall include, but not be limited to:

1. Existing and new slab conditions.
2. Results of mandatory testing.
3. Surface preparation.
4. Required room temperatures.
5. Ventilation.
6. Step-by-step application procedures.
7. Curing time and methods.
8. Protection of completed Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

1. Maintain ambient air temperature between 65oF and 85oF.
2. Type I Concrete substrate shall be properly cured for a minimum of 30 days. Type III Concrete shall be properly cured for a minimum of 7 days.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

1.8 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering 100% of the material and labor costs protecting the client from delamination, disbondment, and osmotic/hydrostatic failure for a period of three (3) years from date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Crossfield Products Corp.
2. Dex-O-Tex.

3. Dur-A-Flex.
4. Koster American Corp.
5. Stonhard, Inc.
6. Tnemec Company Inc.

B. Low-Emitting Materials: Provide adhesives and sealants in compliance with the 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."

C. VOC Content, Floor Coatings: 100 g/L or less.

2.2 RESINOUS FLOORING SYSTEM - EPOXY

A. Troweled epoxy mortar with a chemically resistant, pigmented epoxy topcoat:

1. Basis-of Design Product: “Stonclad GS” by Stonhard, Inc., or approved equal.

B. System Characteristics:

1. Color: To match Architect’s sample.
2. Wearing Surface: Standard smooth.
3. Integral Cove Base: 8 inches high with 1 inch radius.
4. Overall System Thickness: 1/4 inch.

C. System Components: Manufacturer's standard components which are compatible with each other and as follows:

1. Primer - 1:
   a. Basis-of-Design Product: “Stonhard Standard Primer.”
   b. Resin: Epoxy.
   c. Formulation Description: (2) two-component, 100 percent solids.
   d. Application Method: Squeegee, back roll.
      1) Number of Coats: One.

2. Mortar Base:
   a. Basis-of-Design Product: “Stonclad GS.”
   b. Resin: Epoxy.
   c. Formulation Description: (3) three-component, 100 percent solids.
   d. Application Method: Troweled.
      1) Number of Coats: One.
      2) Thickness: Nominal 1/4-inch.
   e. Aggregates: Pigmented blended aggregate.

3. Top Coat:
   a. Basis-of-Design Product: “Stonekote HT4”.
   b. Resin: Epoxy.
   c. Formulation Description: (2) two-component, 100 percent solids, pigmented.
   d. Application Method: Rubber squeegee and medium nap roller.
      1) Number of Coats: One.

2.3 ACCESSORY MATERIALS

A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

1. Basis-of-Design Product: Stonhard “Stonflex MP7” joint fill material.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:
   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
3. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within a range on pH scale not less than 5 or more than 9 pH, or as otherwise required in writing by manufacturer of flooring.
4. Moisture Vapor Emission Testing:
   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, or as otherwise required in writing by manufacturer of flooring.

5. Relative Humidity Testing:
   a. Perform relative humidity test, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level of 75 percent, or as otherwise required in writing by manufacturer of flooring.

6. Perform tests indicated above and as recommended by flooring manufacturer. Proceed with installation only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
   a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners, no broadcast cove permitted.

D. Apply flooring mortars in thickness indicated for flooring system.

1. Trowel apply mortars, when cured grind to remove any trowel marks.

E. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 TERMINATIONS

A. Case edges to lock the flooring system into the concrete substrate along lines of termination.

B. Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

C. Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.4 FIELD QUALITY CONTROL

A. Testing and Monitoring Equipment Calibrations: Test and demonstrate to the Architect that calibrations on testing and monitoring equipment are providing accurate readings.

B. Manufacturer’s Field Service: Manufacturer shall send qualified technical representative to the Project site for the following purposes:

1. Coordinate schedule, environmental requirements, and pre-installation work with other trades.
2. Advise Installer’s personnel of procedures and precautions for use of flooring materials.
3. Attend moisture testing and other testing procedures with the Architect, Owner and Installer in attendance.
4. Observe field mock-ups with the Architect, Owner and Installer in attendance.
5. Make periodic site visits and include record of observations in the applicator’s project documentation log.

6. Ascertain that each component of flooring system is being installed in accordance with manufacturer's instructions.
7. Maintain a log of environmental conditions, work procedures, testing procedures, and protection measures to be included in job site file submittal.

C. Testing of Floor Slabs:

1. Before installation of flooring, test floor slabs for containment of moisture and moisture vapor emission, pH, and alkalinity levels that would be detrimental to adhesion of resinous flooring materials.
2. Complete the following moisture tests as described below and as documented in ASTM E 1907.
    a. Testing of floor slabs for containment of moisture and moisture vapor emission shall be by calcium chloride test method in accordance with ASTM F 1869.
        1) For slabs on grade one test kit shall be placed for every 1000.sq. ft. of concrete slab area
        2) For elevated slabs one test kit shall be placed for every 5000 sq. ft. of concrete slab area
        3) Maximum transmission emission level for slabs on grade shall be 3 lbs of water per every 1000 sq ft. of floor slab area in 24 hour period.
        4) Maximum transmission emission level for elevated slabs shall be 3 lbs. of water per 5000 sq. ft. of floor slab area in 24 hour period.
        5) Protect against rewetting of concrete after testing.
        6) Coordinate environmental controls in advance and continuing for duration of flooring installation.
    b. Perform plastic sheet tests per ASTM D 4263.
    c. Perform relative humidity tests using probes per ASTM F 2170.

3. Perform pH tests per ASTM F 710.
4. Perform additional moisture tests recommended by manufacturer with Achitect's approval.
5. Verify that concrete substrates have neutral pH and that resinous flooring will adhere. Proceed with application only after substrates successfully pass testing listed above.

D. Testing Activities During Resinous Flooring Application: The following may be required by the Architect.

1. Core Sampling: At the direction of the Architect and at locations designated by the Architect, take 1 core sample per 100 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Installer to repair damage caused by coring and correct deficiencies.
2. Material Sampling: Architect may at any time and any number of times during resinous flooring application require the Contractor to collect material samples for testing for compliance with requirements.
    a. Material samples shall be taken, identified, sealed, and certified in presence of Architect.
    b. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures in addition to testing procedures listed in manufacturer's product data.

3. Adhesion Test: Conduct "pull-off" tests on installed flooring in accordance with ASTM D 4501. Certify that results conform to the manufacturer's published maximum for adhesive strength before failure.
4. If test results show applied materials do not comply with specified requirements, Contractor to pay for testing, remove non-complying materials, prepare surfaces coated

with unacceptable materials, and reapply flooring materials in compliance with requirements.

3.5 CLEANING AND PROTECTING

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

SECTION 096800

CARPETING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Carpet tile.
2. Carpet accessories.
3. Substrate preparation for carpet and accessories.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 096510 - RESILIENT FLOORING AND ACCESSORIES for resilient wall base and accessories installed with carpet.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Existing flooring materials to be removed.
3. Existing flooring materials to remain.
4. Carpet type, color, and dye lot.
5. Seam locations, types, and methods.
6. Type of subfloor.
7. Type of installation.
8. Pattern type, repeat size, location, direction, and starting point.
9. Pile direction.
10. Type, color, and location of insets and borders.
11. Type, color, and location of edge, transition, and other accessory strips.
12. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch-long Samples.

D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.

E. Sample Warranties: For special warranties.

F. Maintenance Data: For carpet to include in maintenance manuals specified in Division 01. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.4 QUALITY ASSURANCE

A. Carpeting Standard: Comply with the Carpet and Rug Institute's "CRI Carpet Installation Standard," 2011 edition, formerly CRI 104 "Standard For Installation Specification Of Commercial Carpet."

B. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

C. Mockups: Before installing carpet, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with CRI Carpet Installation Standard, Section 5, "Storage and Handling."

B. Deliver carpet in original mill protective covering with mill register numbers and tags attached.

1.6 PROJECT CONDITIONS

A. General: Comply with CRI Carpet Installation Standard, Section 7, "Site Conditions."

B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

D. Where demountable partitions, equipment, or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.7 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Carpet Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ege Carpets.
2. InterfaceFLOR.
3. J&J Invision Carpet.
4. Milliken & Co.
5. Mohawk Group.
6. Shaw, a Berkshire Hathaway Co.
7. Tandus Centiva, a Tarkett Company.

2.2 CARPET

A. Carpet Products: Subject to compliance with requirements, provide one of the following:

1. Carpet Types (CPT-#): Refer to Finish Schedule.
2. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Product specific Type III EPD.
3. Low-Emitting Materials, General Emissions Evaluation: Carpet and Rug Institute Green Label Plus.
4. Do not permit polyvinyl chloride (PVC) or styrene butadiene rubber (SBR) carpet backing materials.

B. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Smoke Density: Not more than 450, when tested in accordance with ASTM E 662 or NFPA 258.
3. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the carpet manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by carpet manufacturer.

1. Low-Emitting Materials, General Emissions Evaluation: Provide adhesives in compliance with the 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. VOC Content: Not more than 50 g/L.

3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives. Do not use adhesives that contain urea formaldehyde.

C. Adhesive Film, for Carpet Tiles: Pressure sensitive adhesive, applied on one side of a polyester film, recommended by carpet tile manufacturer for releasable installation.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. InterfaceFLOR; TacTiles.
b. Shaw; LokDots Adhesive.
c. Tandus Centiva; TandusTape+

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.

B. Examine carpet for type, color, pattern, and potential defects.

C. Concrete Subfloors: Comply with CRI Carpet Installation Standard, Section 9, “Testing Concrete Substrates.” Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet manufacturer.
2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI Carpet Installation Standard, Section 7.3, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within a range on pH scale not less than 5 or more than 9 pH, or as otherwise required in writing by manufacturer of flooring.
3. Moisture Vapor Emission Testing:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, or as otherwise required in writing by manufacturer of flooring.

4. Relative Humidity Testing:

a. Perform relative humidity test, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level of 75 percent, or as otherwise required in writing by manufacturer of flooring.

5. Perform tests indicated above and as recommended by flooring manufacturer. Proceed with installation only after substrates pass testing.

C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Carpet Tile: Comply with CRI Carpet Installation Standard, Section 18, "Modular Carpet," and with carpet tile manufacturer's written installation instructions.

1. Installation Method, for Adhesive: Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive.
2. Installation Method, for Adhesive Film: Free lay; apply adhesive film squares at corners of tiles.

a. Do not install tiles with adhesive film at stair and ramp locations.
b. Do not install tiles with adhesive film over existing carpets.

3. Installation Method, for No Adhesives: Free lay; press tiles firmly.

a. Do not install tiles without adhesive at stair and ramp locations.
b. Do not install tiles without adhesive over existing carpets.

4. Carpet Tile Pattern: As directed by Architect.
5. Maintain dye lot integrity. Do not mix dye lots in same area.

B. Install pattern parallel to walls and borders.

C. Do not bridge building expansion joints with carpet.

D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.

3. Vacuum carpet using commercial machine with face-beater element and HEPA filter.

B. Protect installed carpet to comply with CRI Carpet Installation Standard, Section 20, "Protecting Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION

SECTION 099000

PAINTING AND COATING

(PART OF WORK OF SECTION 090007 - PAINTING, FILED SUB-BID REQUIRED)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Field painting of exposed interior items and surfaces.
2. Field painting of exposed exterior items and surfaces.
3. Surface preparation for painting.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 051200 - STRUCTURAL STEEL FRAMING for shop priming structural steel.
2. Section 055000 - METAL FABRICATIONS for shop priming ferrous metal.
3. Section 055100 - METAL STAIRS AND RAILINGS for shop priming ferrous metal.
4. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for shop priming interior architectural woodwork.
5. Section 081110 - HOLLOW METAL DOORS AND FRAMES for factory priming steel doors and frames.
6. Section 081400 - FLUSH WOOD DOORS for factory finishing.
7. Section 092110 - GYPSUM BOARD ASSEMBLIES for surface preparation of gypsum board.

1.3 DEFINITIONS AND EXTENT

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

B. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

D. Do NOT paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

   a. Architectural woodwork.
   b. Acoustical wall panels.
   c. Toilet enclosures.
   d. Metal lockers.
   e. Kitchen appliances.
   f. Elevator entrance doors and frames.
   g. Elevator equipment.
   h. Finished mechanical and electrical equipment.
   i. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

   a. Foundation spaces.
   b. Furred areas.
   c. Ceiling plenums.
   d. Utility tunnels.
   e. Pipe spaces.
   f. Duct shafts.
   g. Elevator shafts.

3. Finished metal surfaces include the following:

   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper and copper alloys.
   e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:

   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

a. Disclose material ingredients by name and Chemical Abstract Service (CAS) Registry Number.

2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Submit two 8 inch by 12 inch Samples for each type of finish coating for Architect's review of color and texture only.

C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Mockups: Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.

a. Wall Surfaces: Provide samples on at least 100 sq. ft.
b. Small Areas and Items: Architect will designate items or areas required.

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS (ATTIC STOCK)

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: Furnish one unopened gallon of each type of paint and coating work, in color and gloss as used for the Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work are listed in the Finish Schedule at the end of this Section.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Paint Colors (PT-#): Provide colors as selected by Architect. Refer to Finish Schedule.

D. Low-Emitting Materials: Interior paints and coatings shall comply 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."

E. VOC Content Limits, for Interior Paints and Coatings:

1. Default: 50 g/L.
2. Dry-Fog Coatings: 50 g/L.
3. Flats: 50 g/L.
4. Floor Coatings: 50 g/L.
5. Industrial Maintenance (IM) Coatings: 100 g/L.
6. Color indicating safety coatings: 480 g/L.
7. Zinc rich IM primers: 100 g/L.
8. Metallic pigmented coatings: 150 g/L.
9. Multi-color coatings: 250 g/L.
10. Non-flat coatings: 50 g/L.
11. Pre-treatment wash primers: 420 g/L.
12. Primers, sealers and undercoaters: 100 g/L.
13. Shellacs, Clear: 730 g/L.
14. Shellacs, Pigmented: 550 g/L.
15. Specialty Primers: 100 g/L.
16. Stains: 100 g/L.
17. Stains, Interior: 250 g/L.
18. Wood Coatings, Varnish: 275 g/L.
19. Wood Coatings, Sanding Sealer: 275 g/L.
20. Wood Coatings, Lacquer: 275 g/L.
21. Wood Conditioners: 100 g/L.
22. Colorant Added to Architectural Coatings, excluding IM coatings: 50 g/L.
23. Colorant Added to Solvent Based IM: 600 g/L.

24. Colorant Added to Waterborne IM: 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
2. Use low-emitting, environmentally friendly cleaning agents and procedures, including but not limited to trisodium phosphate (TSP) diluted with warm water. Do not use ammonia-, chlorine bleach-, or solvent-based cleaners, unless authorized in writing by Architect.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions and technical bulletins for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
c. If transparent finish is required, backprime with clear sealer.
d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

a. Exterior Exposed Steel: Clean steel surfaces in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning. Abrasive blast cleaned surfaces shall exhibit a uniform, angular profile of 1.5-3.0 mils. Prime cleaned surfaces within 8 hours and prior to surface rusting.
b. Interior Exposed Steel, in Humid Environments: Clean steel surfaces in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning. Abrasive blast cleaned surfaces shall exhibit a uniform, angular profile of 1.5-3.0 mils. Prime cleaned surfaces within 8 hours and prior to surface rusting.
c. Interior Exposed Steel, in Dry Environments: Clean steel surfaces in accordance with SSPC-SP2 or SP3 Hand or Power Tool Cleaning.

5. Galvanized Surfaces: Clean galvanized surfaces in accordance with SSPC-SP16 Brush off Blast Cleaning of Galvanized Steel and NonFerrous Metals, to achieve a minimum 1 mil anchor profile.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors and doors in wet areas on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.
2. Uninsulated plastic piping.
3. Pipe hangers and supports.
4. Tanks that do not have factory-applied final finishes.
5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.
2. Panelboards.
3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
2. Testing agency will perform appropriate tests for the following characteristics as required by the Architect.

3. The Architect may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 PAINT SCHEDULE

A. Schedule: Provide products and number of coats specified. Use of manufacturer's proprietary product names to designate colors, materials, generic class, standard of quality and performance criteria and is not intended to imply that products named are required to be used to the exclusion of equivalent performing products of other manufacturers.

B. Exterior Paint Schedule:

1. Exterior Galvanized Metal (not shop-finished under Section 051200 - STRUCTURAL STEEL FRAMING, Section 055000 - METAL FABRICATIONS, Section 055100 - METAL STAIRS AND RAILINGS, and Section 081100 - HOLLOW METAL DOORS AND FRAMES), Alliphatic Acrylic Polyurethane System (Solvent-Based):

a. Surface Preparation: SSPC-SP16 Brush-off Blast of Galvanized Steel.
b. One Coat: Polyamide epoxy, high solids, low VOC, intermediate coat.

1) AkzoNobel; International Intergard 475 HS at 5.0-10.0 mils DFT.
2) Axalta (formerly Dupont); Corlar 2.1 ST at 3.0-5.0 mils DFT.
3) PPG; PMC Amerlock 400 Hi-Build Epoxy at 4.0-5.0 mils DFT.
4) Tnemec; V69 Hi-Build Epoxoline at 3.0 mils DFT (Basis of Design).

c. And One Coat: Aliphatic acrylic polyurethane, finish coat, semigloss.

1) AkzoNobel; International Interthane 990V at 2.0-3.0 mils DFT.
2) Axalta (formerly Dupont); Imron 2.1 SG at 2.0-4.0 mils DFT.
3) PPG; PMC Amercoat 450 HSG at 3.0 mils DFT.

4) Tnemec; 1095 Endura-Shield at 3.0 mils DFT (Basis of Design).

2. Exterior Fiber Cement Board, for Painted Finish:

a. Factory Primed per Section 074610 - FIBER-CEMENT SIDING.
b. Two Coats, Flat Finish:

1) Duron Weathershield Exterior 100% Acrylic Flat House Paint 34-914.
2) PPG; Speedhide flat finish 6-610XI.
3) S-W; SuperPaint Exterior Latex Acrylic Flat A80 series.
4) California Paint Fresh Coat 100& Acrylic Velvet Flat 450 series.

c. Two Coats, Semi-Gloss Finish:

1) Duron Weathershield Exterior 100% Acrylic Semi-Gloss House Paint.
2) PPG; Speedhide semi-gloss finish 6-900XI.
3) S-W; SuperPaint Exterior Latex Acrylic Satin A89 series.
4) California Paint Fresh Coat Satin-Gloss 100% Acrylic 471 series.

C. Interior Paint Schedule, Typical:

1. Interior Gypsum Wallboard (GWB), Latex Paint Finish:

a. One Coat, Primer: MPI 50 X-Green and 149 X-Green.

1) Moore; Ultra Spec 500 Interior Latex Primer N534.
2) PPG; Speedhide Pro EV Zero VOC Interior Primer 12-900XI series.
3) S-W; ProMar 200 HP Zero VOC Interior Primer.

b. And Two Coats, Flat Finish: At ceilings and elsewhere as indicated. MPI 53 X-Green.

1) Moore; Ultra Spec 500 Interior Latex Flat T536.
2) PPG; Speedhide Pro EV Zero VOC Interior Latex Flat 12-110XI series.
3) S-W; ProMar 400 HP Zero VOC Interior Flat.

or

c. And Two Coats, Eggshell Finish: At walls and elsewhere as indicated. MPI 144 X-Green.

1) Moore; Ultra Spec 500 Interior Latex Eggshell T538.
2) PPG; Speedhide Pro EV Zero VOC Interior Latex Eggshell 12-110XI series.
3) S-W; ProMar 200 HP Zero VOC Interior Eg-Shel.

or

d. And Two Coats, Semi-Gloss Finish: At toilet rooms, other wet areas, and elsewhere as indicated. MPI 54 X-Green.

1) Moore; Ultra Spec 500 Interior Latex Semi-Gloss T546.
2) PPG; Speedhide Pro EV Zero VOC Interior Latex Semi-Gloss 12-110XI series.
3) S-W; ProMar 200 HP Zero VOC Interior Semi-Gloss.

2. Interior Architectural Woodwork, Finish Carpentry, and Wood Doors (softwoods, paint grade hardwoods, MDF, MDO, and hardwood veneers), Latex Paint Finish:

    a. One Coat, Primer:

        1) Moore; Ultra Spec 500 Interior Latex Primer N534.
        2) PPG; Pure Performance Interior Latex Primer 9-900.
        3) PPG; Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 series.
        4) PPG; Speedhide Zero VOC Interior Primer 6-4900XI series.
        5) PPG; Speedhide Pro EV Zero VOC Interior Primer 12-900XI series.
        6) S-W; ProMar 200 HP Zero VOC Interior Primer.

    b. And Two Coats, Semi-Gloss:

        1) Moore; Ultra Spec 500 Interior Latex Semi-Gloss T546.
        2) PPG; Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
        3) S-W; ProMar 200 HP Zero VOC Interior Semi-Gloss.

3. Interior Architectural Woodwork, Finish Carpentry and Millwork (hardwoods and hardwood veneers, except paint grade and factory-finished items), Transparent Polyurethane Finish:

    a. Sand: 120 grit sandpaper.
    b. Sand: 220 grit sandpaper.
    c. One Coat, Stain: Not Used.
    d. And Three Coats, Satin Finish:

        1) American Formulating & Manufacturing; Safecoat Polyureseal BP.
        2) Imperial Paints; ECOS Clear Varnish.
        3) Moore; Benwood Stays Clear Acrylic Polyurethane Low Lustre W423.
        4) PPG; DEFT water-based polyurethane 158.
        5) Vermont Natural Coatings; PolyWhey Natural Furniture Finish.

    e. Sand Between Urethane Coats: 220 grit sandpaper.

4. Interior Concrete Masonry Unit (CMU), Latex Paint Finish:

    a. One Coat, Block Filler:

        1) Moore; Ultra Spec Hi-Build Masonry Block Filler 571.
        2) PPG; Perma-Crete 4-603. Less than 100 g/L.
        3) PPG; Speedhide Interior Masonry Hi Fill Latex Block Filler 6-15XI.
        4) S-W; PrepRite Block Filler B25W25.

    b. And Two Coats, Eggshell Finish: At walls and elsewhere as indicated.

        1) Moore; Ultra Spec 500 Interior Latex Eggshell T538.
        2) PPG; Speedhide Zero VOC Interior Latex Eggshell 6-4310XI series.
        3) S-W; ProMar 200 HP Zero VOC Interior Eg-Shel.

5. Interior Metals (Not specified to receive other coating systems/not shop finished), Acrylic Paint Finish:

a. One Coat: Approved primer, in shop under other Sections (where specified). If not shop primed, provide primer recommended by finish coating manufacturer.

1) Moore; Ultra Spec HP Acrylic Metal Primer HP04.

b. And Two Coats:

1) Moore; Ultra Spec 500 Interior Latex Semi-Gloss T546.
2) PPG; Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
3) S-W; ProMar 200 HP Zero VOC Interior Semi-Gloss.

6. Interior Exposed Steel, Joists, Ductwork, Conduit and Similar Items (where indicated), Waterborne Dry-Fall or Dry-Fog Painted System:

a. One Coat:

1) Moore; Latex Dry Fall Flat 395 at 2.5 to 3.0 mils DFT.
2) PPG; Speedhide Super Tech WB Interior Dry-Fog Latex 6-725XI Flat at 2.0 to 2.5 mils DFT.
3) S-W; WB Pro Industrial Waterborne Acrylic Dryfall Flat B42 series at 2.5 to 3.0 mils DFT.
4) Tnemec 115 WB Unibond DF at 2.5 to 3.0 mils DFT.

7. Interior Concrete Floor, Clear Exposed Sealer (Silicate type):

a. One Coat:

1) Curecrete Chemical; Ashford Formula.
2) Tnemec (Chem Probe); Series 629 CT Densifyer.
3) WR Meadows; Liqui-Hard.
4) Laticrete; L&M Seal Hard.
5) Prosoco; Consolideck LS.

D. Mechanical and Electrical Work: Paint all exposed items throughout the project except factory finished items with factory-applied baked enamel finishes which occur in mechanical rooms or areas, and excepting chrome or nickel plating, stainless steel, and aluminum other than mill finished. Paint all exposed ductwork and inner portion of all ductwork. Same as specified for other interior metals, hereinabove.

END OF SECTION

SECTION 101100

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Markerboards.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for custom wood trim for visual display surfaces.
2. Section 099000 - PAINTING AND COATING for primers under marker wall covering.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:

1. Actual sections of visual display surfaces.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show location of panel joints.
2. Show location of special-purpose graphics for visual display surfaces.
3. Include sections of typical trim members.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

E. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of visual display surface through one source from a single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display units vertically with packing materials between each unit.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
2. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

PART 2 - PRODUCTS

2.1 MARKERBOARD ASSEMBLIES

A. Glass Markerboards: 6-mm tempered glass, magnetic markerboard, with smooth polished edge and eased corners; color coated on back surface.

1. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
2. Mounting: Manufactures standard invisible mounting system.
3. Color and Surface: As selected by the Architect.
4. Marker Tray: Magnetic glass, supported by stainless-steel clips.

2.2 ACCESSORIES

A. Aluminum Frames and Trim: Factory-applied, fabricated from not less than 0.062-inch-thick, extruded aluminum; of size and shape indicated.

B. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific visual display surfaces and substrate application, as recommended in writing by visual display surface manufacturer.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to neat, hairline closure.

2.4 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

1. Join adjacent wall panels with concealed steel splines for smooth alignment.

2. Where markerboards abut, install with clean, trimless butt joints.

3.4 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION

SECTION 101400

SIGNAGE

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Code-required interior panel signage, including but not limited to, accessibility signage, toilet room signage and mechanical and electrical room signage.
2. Exterior building signage.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Division 26 - ELECTRICAL for illuminated exit signs.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.

1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.

C. Samples for Verification: For each type of sign, include the following Samples to verify color selected:

1. Panel Signs: Full-size Samples of each type of sign required.
2. Approved samples will not be returned for installation into Project.

D. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

B. Regulatory Requirements: Comply with the Massachusetts Architectural Access Board, Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

PART 2 - PRODUCTS

2.1 PANEL SIGNS

A. General: Provide signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction as indicated. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally. Provide the following:

1. Code-Required Signs for Certificate of Occupancy:

a. Type: Photopolymer on acrylic or printed acrylic / aluminum as applicable.
b. Color: Selected from manufacturer’s standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal.
c. Type Size: As indicated on Drawings.
d. Typeface: As selected by Architect from Manufacturer’s full range.

2. Interior Signs Based on Owner’s Requirements:

a. Type: Photopolymer on acrylic or printed acrylic as applicable.
b. Color: Selected from manufacturer’s standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal.
c. Type Size: As indicated on Drawings.
d. Typeface: As selected by Architect from Manufacturer’s full range.

3. Exterior Signs:

a. Type: As indicated on the Drawings.

B. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Raised-Copy Thickness: Not less than 1/32 inch

C. Symbols of Accessibility: Provide 6-inch- high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.

2.2 ACCESSORIES

A. Mounting Methods: Use double-sided vinyl tape fabricated from materials that are not corrosive to sign material and mounting surface.

B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items provided under other sections of Work are sized and located to accommodate signs.

C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:

1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by the Architect.

END OF SECTION

SECTION 102110

TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Solid plastic toilet compartments and screens, floor-mounted and overhead braced.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 102800 - Toilet Accessories for partition mounted accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.

C. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

A. Fire Hazard Classification: Passes NFPA 286.

B. Regulatory Requirements: Comply with applicable provisions of Massachusetts Architectural Access Board and the Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG) for compartment door operating hardware and compartments designated as accessible."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

1.6 COORDINATION

A. Coordinate with the work of Section 061000 - ROUGH CARPENTRY for locations requiring wood blocking or flat plate reinforcing within partitions for compartment mounting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Accurate Partitions Corporation.
2. General Partitions Mfg. Corp.
3. Global Partitions.
4. Scranton Products

2.2 RECYCLED PLASTIC UNITS

A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

B. Stainless-Steel Castings: ASTM A 743/A 743M.

C. Door, Panel, and Pilaster Construction: Solid, recycled high-density polyethylene (HDPE) material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range of colors and patterns.
2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.

D. Brackets and Fittings: Manufacturer's standard designs.

1. Material: Stainless steel.
2. Full-Height (Continuous) Type Brackets: Stainless steel.
3. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
4. Stainless-Steel Finish: No. 4 bright, directional polish on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
2. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Floor-Mounted, Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Floor-Mounted, Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION

SECTION 102600

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Corner guards.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS.
2. Section 087100 - DOOR HARDWARE for metal armor, kick, mop, and push plates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Corner Guards: 12 inches long.

C. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Sections.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: ASTM B221, Alloy 5005 H34.

B. Fasteners: Nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 80 g/L.
3. Special Purpose Contact Adhesive: 250 g/L.

2.2 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated from 1-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Balco, Inc.
    b. Boston Retail Products.
    c. Construction Specialties, Inc.
    d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
    e. Korogard Wall Protection Systems; Division of RJF International Corporation.
    f. Nystrom Building Products.
    g. Pawling Corporation.

2. Material: Aluminum.

    a. Thickness: Minimum 0.0781 inch.
    b. Finish: Powder coated, color to be selected by Architect from Manufacturer's full range.

3. Basis of Design: Construction Specialties, Inc.; CS Acrovyn.
4. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
5. Corner Radius: 3/16 inch.
6. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.3 FABRICATION

A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.4 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Remove tool and die marks and stretch lines or blend into finish.
2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Provide mounting hardware, anchors, and other accessories required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a low VOC, non-ammonia-, non-chlorine, and non-solvent-based, household cleaning agent.

END OF SECTION

SECTION 102800

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Toilet accessories as scheduled on the Drawings. Coordinate with Owner for accessories provided by Owner.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for blocking.
2. Section 088000 - GLAZING for frameless mirrors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. Excel Dryer, Inc.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.

C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.3 HAND DRYER

A. Basis of Design: Excel Dryer, Inc.; Xlerator Hand Dryer, XL-BW.

1. Dry Time: 8 seconds.
2. Energy Use per Use: 3.7 Wh.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 104400

FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Portable fire extinguishers.
2. Fire-protection cabinets for portable fire extinguishers.
3. Mounting brackets for fire extinguishers.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 099000 - PAINTING AND COATING for field painting fire-protection cabinets.
2. Division 21 - FIRE PROTECTION for fire hose valves and standpipes.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each item.

1. Fire Extinguishers: Include rating and classification.
2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

PART 2 - PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 FIRE-PROTECTION CABINET

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. JL Industries, Inc.
2. Larsen's Manufacturing Company.
3. Nystrom Building Products.
4. Potter Roemer; Div. of Smith Industries, Inc.

B. Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Material: Stainless sheet with #8 mirror finish.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. Trimless with Plaster Stop: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as plaster stop. If wall condition does not allow for trimless with plaster stop, provide flat 5/16 inch trim of same material as the cabinet box.

E. Door Material: Steel stainless sheet with #8 mirror finish.

F. Door Style: Vertical duo panel with frame and vertical white lettering.

G. Door Glazing: Tempered glass.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

I. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick, fire-barrier material.

a. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging. Contractor shall be responsible for fire extinguisher tagging by a certified service technician located within 75 miles of the project.

1. Remove and replace damaged, defective, or undercharged units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated on the Drawings and acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

D. Identification: Apply vinyl lettering at locations indicated.

3.4 INSTALLATION OF FIRE-RATED CABINETS

A. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.

B. Seal through penetrations with firestopping sealant as specified in Section 078410 - PENETRATION FIRESTOPPING.

3.5 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 105143

WIRE MESH STORAGE LOCKERS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Wire mesh storage lockers, for gear storage.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 087100 - DOOR HARDWARE for lock cylinders and keying.
2. Division 26 - ELECTRICAL.

1.3 DEFINITIONS

A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design wire mesh storage lockers, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide wire mesh storage lockers capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As required by code, and as indicated on Structural Drawings.

C. Seismic Performance: Wire mesh storage lockers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.0.

1.5 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments.

C. Samples: For units with factory-applied color finishes.

D. Delegated-Design Submittal: For wire mesh storage lockers indicated to comply with performance requirements and design criteria

1. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For Installer and Professional Engineer.

F. Welding certificates.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products or an employer of workers trained and approved by manufacturer.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data; inspection of framing installation during construction; by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire mesh storage lockers to provide protection during transit and Project-site storage. Use vented plastic.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh storage lockers by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cogan Wire and Metal Products Ltd.
2. Folding Guard Corporation.
3. GearGrid Corporationg.
4. Jesco Industries, Inc.

5. WireCrafters LLC.

B. Basis of Design: GearGrid Corporation; GEARGRID Wall Mount and Freestanding Units.

2.2 MATERIALS

A. Steel Wire: ASTM A 510.

B. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.

C. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.

E. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.

F. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

G. Power-Driven Fasteners: ICC-ES AC70.

H. Seismic Bracing: Angles with legs not less than 1-1/4 inch wide, formed from 0.040-inch- thick, metallic-coated steel sheet; with bolted connections and 1/4-inch- diameter bolts.

I. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

J. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.

K. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.3 WIRE MESH STORAGE LOCKERS

A. Unit Sizes: As indicated on Drawings.

B. Construction: Units shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knock- down shipping, securing units to mounting surface and on applicable accessories.

C. Vertical Dividers:

1. Outer Frames: 1.25” O.D. x 16 gauge wall thickness ASTM A513 steel tubing.
2. Inner Grid: .25” diameter ASTM 510 cold drawn steel wire resistance welded to a 3” square pattern.

3. Inner Grid wires must be full length and width of inside vertical divider frame. Wires not running full length or width, thus creating exposed wire ends will not be acceptable.
4. Inner Grid wires must run horizontally and vertically creating a square or rectangular grid pattern only. Grid wires not creating a square or rectangular grid pattern will not be acceptable.
5. Inner Grid wires shall intersect and cross all perpendicular wires, and shall be welded at all intersections.

D. Back Panels:

1. Required on each locker to protect the locker contents and wall substrate, as well as provide an additional panel for accessory attachment.
2. Grid: .25” diameter ASTM 510 cold drawn steel wire resistance welded to a 3” square pattern.
3. Back panel must engage and be secured to vertical dividers via horizontal wires which extend into mounting holes pre-drilled in vertical dividers. Back panels are sandwiched between vertical dividers, preventing them from being removed after assembly is complete.
4. Inner Grid wires must be full length and width of inside vertical divider frame. Wires not running full length or width, thus creating exposed wire ends will not be acceptable.
5. Inner Grid wires must run horizontally and vertically creating a square or rectangular grid pattern only. Grid wires not creating a square or rectangular grid pattern will not be acceptable.
6. Inner Grid wires shall intersect and cross all perpendicular wires, and shall be welded at all intersections.

E. Shelves: (1) Upper, (1) Lower. .25” diameter ASTM 510 cold drawn steel wire resistance welded and cold formed. Upper shelf includes a 20 gauge steel bracket to accept a 2” x 16” name placard.

F. Apparel Hooks: (3) per locker opening. .192” diameter ASTM 510 cold drawn steel wire resistance welded, cold formed and powder coated. Apparel hooks must securely engage and snap onto side or back grid, to prevent unintentional disengagement of hook.

2.4 ACCESSORIES

A. Hang Bar:

1. Hang Bars must be manufactured to allow each locker user to install at their desired height. Hang Bars that span multiple locker openings are not acceptable.
2. Tube: 1.25”O.D. x 16 gauge 304 stainless steel tubing.
3. Brackets: Allow Hang Bars to be securely attached to each vertical divider, powder coated.

B. Secure Box: 6” wide x 6” high x 12” deep 6061 Aluminum enclosure with hinged, lockable door at outer end. Design shall include an integrated mail slot. Powder coated finish in specified color.

C. Power Bar: 16 gauge steel chase integrated into the upper framework of the locker assembly allowing provision for the installation of a 120VAC duplex outlet at each locker location. Powder coated finish in specified color.

2.5 FABRICATION

A. General: Fabricate wire mesh storage lockers from components of sizes not less than those indicated. Use larger size components as recommended by wire mesh manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh storage lockers to be readily disassembled.
2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

B. Wire Mesh Storage Lockers: Fabricate initial storage locker with front and two sides. Fabricate additional storage lockers as add-on units designed to share one side with initial storage locker.

1. Fabricate wall panel and door framing with slotted holes for connecting adjacent panels.
2. Prehang doors in factory.

2.6 FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

D. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where wire mesh storage lockers will be installed.

C. Examine walls to which wire mesh storage lockers will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRE MESH STORAGE LOCKERS ERECTION

A. Anchor wire mesh storage lockers to floor with 3/8-inch- diameter expansion anchors at 12 inches o.c. through bottom panel framing. Shim panel framing as required to achieve level and plumb installation.

1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.

B. Anchor wire mesh storage lockers to walls at 12 inches o.c. through back corner panel framing and as follows:

1. For concrete and solid masonry anchorage, use expansion anchors.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

C. Attach adjacent wire mesh storage lockers to each other through side panel framing.

D. Install horizontal dividers/shelving in double-tier storage lockers.

E. Install doors complete with door hardware.

3.3 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly and easily without binding or warping. Adjust hardware to function smoothly. Confirm that hasps engage accurately and securely without forcing or binding.

B. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 113100

APPLIANCES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Appliances.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Division 22 - PLUMBING for water distribution piping connections, drainage and vent piping connections, sinks, and waste disposers.
2. Division 26 - ELECTRICAL for services and connections to appliances.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.

B. Appliance Schedule: For appliances; use same designations indicated on Drawings.

C. Maintenance Data: For each product to include in maintenance manuals.

D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Provide products from same manufacturer for each type of appliance required.

C. Regulatory Requirements: Comply with provisions of the following product certifications:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
3. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.

D. Regulatory Requirements, Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with Massachusetts Architectural Access Board requirements and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

E. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.

1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

F. Switches: Provide mercury-free switches in appliances.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer of each appliance specified agrees to repair or replace residential appliances or components that fail in materials or workmanship within manufacturer's standard warranty period.

PART 2 - PRODUCTS

2.1 APPLIANCE SCHEDULE

A. Full Size Refrigerator: Sub-Zero; CL3650UID/S, 36 inch Classic Over-and-Under Refrigerator/Freezer with Internal Dispenser. Pull Type: Pro. Quantity (2)

B. Under Counter Refrigerator: Summit Appliance Division; Accuc-ID FF7BISSHHADA, ADA compliant built-in undercounter all-refrigerator. Quantity (1)

C. Countertop Microwave: GE; Profile Series PEM31SF/EF/BM/FM, 1.1 cubic foot countertop microwave oven. Quantity (2)

D. Dishwasher: GE; GDT226S Stainless Steel Interior Dishwasher with Hidden Controls. Quantity (2)

E. Range Hood, UL507-listed: CaptiveAire; Models WRH-30 & WRH-60, Wall Residential Hood, with UL 300 Fire Suppression System and Straight Wrapper . Quantity (1) each.

F. Range: Wolf; DF6065DG/S/P, 60 inch Dual Fuel Range, 6 Burners and Infrared Dual Griddle. Quantity (1)

G. Charbroiler: Vollrath; Model: CBGHD-24, 24 inch Radiant HD Gas Charbroiler. Quantity (1)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to Division 22 - PLUMBING for plumbing requirements and Division 26 - ELECTRICAL for electrical requirements.

3.3 CLEANING AND PROTECTION

A. Test each item to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from appliances and leave units in clean condition, ready for operation.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner’s maintenance personnel to adjust, operate, and maintain appliances.

END OF SECTION

SECTION 122400

SHADES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Roller shades with manual and motorized shade operators, including skylight shades.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood blocking and grounds for mounting roller shades and accessories.
2. Division 26 - ELECTRICAL for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
2. Motorized Shade Operators: Include operating instructions.
3. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. Wiring Diagrams: Power, system, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members and attachment to building structure.

2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
3. Shade mounting assembly and attachment.
4. Size and location of access to shade operator and adjustable components.
5. Minimum Drawing Scale: 1/4 inch = 1 foot.

D. Samples for Initial Selection: For each colored component of each type of shade indicated.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated.
2. For the following products:

a. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.
b. Valance: Full-size unit, not less than 12 inches long.

F. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

G. Product Certificates: For each type of roller shade, signed by product manufacturer.

H. Qualification Data: For Installer.

I. Product Test Reports: For each type of roller shade.

J. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.
4. Motorized shade operator.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Draper Inc.
2. Hunter Douglas Contract; Nysan Shading Systems.
3. Lutron Electronics Co.
4. MechoShade Systems, Inc.

2.2 ROLLER SHADES

A. Shadecloth: 100% polyester or PLA biopolymer fabric, PVC-free.

1. Solar Control Type: Provide transparent type shadecloth with percentage as acceptable to Architect.
2. Black-Out Type: Provide black-out type shadecloth at selective locations as directed by Architect.
3. Fire-Test-Response Characteristics: Passes NFPA 701, with no chemical flame retardants.
4. Building Product Disclosure and Optimization, Material Ingredients: Cradle to Cradle (C2C) Gold certification.

5. Low-Emitting Materials: Provide adhesives and sealants in compliance with the 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."

    a. GreenGuard Gold certification.

6. Bottom Hem: Straight.
7. Colors: To be selected by Architect from manufacturer’s full range.

B. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material.

1. Direction of Roll: Regular, from back of roller

C. Mounting Brackets: Galvanized or zinc-plated steel.

D. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings removable design for access.

E. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.

F. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.

G. Bottom Bar: Steel or extruded aluminum. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

H. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard for anchoring roller shade bottom in place and keeping shade band material taut.

2.3 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

2.4 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.

2.5 MOTORIZED ROLLER SHADE OPERATORS

A. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.

B. Comply with NFPA 70.

C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

D. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.

1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
2. Motor Characteristics: Single phase, 220 V, 60 Hz.
3. Motor Mounting: Within manufacturer's standard roller enclosure.

E. Position of Motor and Electrical Connection: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.

F. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following devices for remote-control activation of shades:

1. Control Stations: Keyed, maintained-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.

a. Color: White.

2. Group Control Stations: Maintained-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for single-switch group control.

a. Color: White

3. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

H. Operating Function: Stop and hold shade at any position

I. Operating Features: Include the following:

1. Group switching with integrated switch control; single face plate for multiple switch cut-outs.
2. Capable of interface with audiovisual control system.
3. Capable of accepting input from building automation control system.
4. Override switch.
5. Backup gear and crank operator for manual operation during power failures with detachable handle, length required to make operation convenient from floor level

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Sections for contract closeout procedures.

END OF SECTION

SECTION 124810

ENTRANCE FLOOR MATS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Surface mounted roll-up type entry mat.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product indicated.

1. Floor Mat: 12-inch- square sections of floor mat.

C. Maintenance Data: For floor mats to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats through one source from a single manufacturer.

B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and the Massachusetts Architectural Access Board.

1.5 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 FLOOR MATS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Roll-up Aluminum Rail Hinged Mats:

a. AFCO-USA.
b. Balco, Inc.
c. Construction Specialties, Inc.
d. Mats Inc.
e. Nystrom.

2. Basis of Design: Balco, Inc.; FMS Roll-Up Floor Mats

B. Roll-up Aluminum Rail Hinged Mats: Clear-anodized finish, extruded-aluminum tread rails with heavy duty carpet inserts.

1. Thickness: 0.35 inches.
2. Tapered Frame: Tapered vinyl frame members, not less than 1-1/2 inches wide, with mitered corners.

2.2 FABRICATION

A. General: Where possible, verify sizes by field measurement before shop fabrication.

B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

C. With manufacturer's standard protective coating, coat surfaces of aluminum frames that will contact cementitious material.

2.3 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.4 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate for compliance with requirements for proper installation of floor mats. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install mats in accordance with manufacturer's recommendations, approved submittals, and in proper relationship with adjacent construction. Coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.

3.3 PROTECTION

A. Defer installation of floor mats until Project is near Substantial Completion.

END OF SECTION

SECTION 140001

ELEVATORS

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 140001 – ELEVATORS

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.

3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

A-000 STANDARD NOTES, ABBREVIATIONS, TYP. PARTITION TYPES & MOUNTING HEIGHTS
A-002 CODE REPORT & ANALYSIS
A-010 SITE PLAN
A-100 BASEMENT PLAN
A-101 FIRST FLOOR PLAN
A-102 SECOND FLOOR PLAN
A-110 ROOF PLAN
A-300 EXTERIOR ELEVATIONS

A-301 EXTERIOR ELEVATIONS
A-302 PROPOSED 3D VIEWS
A-400 BUILDING SECTIONS
A-401 BUILDING SECTIONS
A-402 BUILDING SECTIONS
A-403 BUILDING SECTIONS
A-600 ELEVATOR DRAWINGS

S-011 TYPICAL FOUNDATION DETAILS – 2
S-140 LOW ROOF FRAMING PLAN
S-150 HIGH ROOF FRAMING PLAN

1.2 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. All Work of Section 142100 – ELECTRIC TRACTION ELEVATORS

END OF SECTION

SECTION 142100

ELECTRIC TRACTION ELEVATORS

(Part of Work of Section 140001 - ELEVATORS, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Machine-room-less electric traction passenger elevators.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 051200 - STRUCTURAL STEEL FRAMING for the hoist beams, attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
2. Section 055000 - METAL FABRICATIONS for miscellaneous framing and supports for hoisting machines, and for elevator door sills, cants in hoistways made from sheet steel, and elevator pit ladders.
3. Division 093000 - TILING for floor finish requirements.
4. Division 26 - ELECTRICAL for telephone service to elevators.
5. Division 26 - ELECTRICAL for electrical service for elevators to and including disconnect switches at machine room door and telephone wiring to elevator.

1.3 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
2. Car enclosures and hoistway entrances.
3. Operation, control, and signal systems.

B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, equipment layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch-square Samples of sheet materials; and 4-inch lengths of running trim members.

D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

E. Qualification Data: For Installer.

F. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

G. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

H. Warranty: Special warranty specified in this Section.

I. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain elevators through one source from a single manufacturer.

1. Provide major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

C. Regulatory Requirements: Comply with ASME A17.1 and Massachusetts Elevator Code.

D. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG) and the Massachusetts Architectural Access Board.

E. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.

C. Coordinate locations and dimensions of other work relating to traction elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Include 24-hour-per-day, 7-day-per-week emergency callback service.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering electric traction elevators that may be incorporated into the Work include, but are not limited to, the following:

1. KONE Inc.; MonoSpace 300 Dx.
2. Otis Elevator Co.; Gen2 Stream.
3. TK Elevator; evolution 200.

B. Basis of Design: KONE Inc.; MonoSpace 300 Dx.

1. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

2.2 PASSENGER ELEVATORS

A. Elevator No.:

1. Type: Machine-room-less (MRL), gearless traction.
2. Rated Load: 3500 lb.
3. Rated Speed: 150 fpm.
4. Auxiliary Operations:

    a. Battery-powered lowering.
    b. Nuisance call cancel.

5. Car Enclosures: As follows:

    a. Inside Width: As indicated on the Drawings.
    b. Inside Depth: As indicated on the Drawings.
    c. Inside Height: As indicated on the Drawings.
    d. Front Walls: Satin stainless steel with integral car door frames.
    e. Car Fixtures: Satin stainless steel.
    f. Side and Rear Wall Panels: Satin stainless steel.
    g. Reveals: Satin stainless steel.
    h. Door Faces (Interior): Satin stainless steel.
    i. Door Sills: Aluminum.
    j. Ceiling: Satin stainless steel, with LED downlights.
    k. Handrails: Satin stainless steel, at side and rear walls.
    l. Floor prepared to receive flooring indicated.

6. Hoistway Entrances: As follows:

    a. Width: As indicated on the Drawings
    b. Height: As indicated on the Drawings.
    c. Type: Single-speed side sliding.
    d. Frames: Satin stainless steel.
    e. Doors: Satin stainless steel.
    f. Sills: Aluminum.

7. Hall Fixtures: Satin stainless steel.
8. Additional Requirements: As follows:

    a. Provide inspection certificate in each car, mounted under acrylic cover with satin stainless-steel frame.
    b. Provide protective blanket hooks in all cars and two complete sets of full-height blankets.

9. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

2.3 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.

B. Elevator Machines: Provide variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines. Provide solid-state power converters.

1. Provide regenerative or nonregenerative system.
2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

C. Fluid for Oil Buffers: If oil buffers are used, use only fire-resistant hydraulic fluid containing antioxidant, anticorrosive, antifoaming, and metal-passivating additives.

1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Hydro Safe (FR)" by Hydro Safe Oil Division, Inc.

D. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.

E. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 Section "Metal Fabrications" for materials and fabrication.

F. Car Frame and Platform: Welded steel units.

G. Guides: Provide roller guides or polymer-coated, nonlubricated sliding guides at top and bottom of car and counterweight frames.

2.4 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system for each elevator as required to provide type of operation system indicated.

B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in

machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Provide stripe-swipe card reader integral with each car control station.

2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.5 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

2.6 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, satin (No. 4) finish.

1. Textured Stainless-Steel Sheet: Product with embossed texture rolled into exposed surface.

E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304, satin (No. 4) finish.

F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

G. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

2.7 CAR ENCLOSURES

A. General: Provide enameled-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
2. Provide finished car including materials and finishes specified below.

B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:

1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch nominal thickness.
2. Fabricate car with recesses and cutouts for signal equipment.
3. Fabricate car door frame integrally with front wall of car.
4. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
5. Sight Guards: Provide sight guards on car doors.
6. Sills: Extruded nickel silver, with grooved surface, 1/4 inch thick.

7. Handrails: Manufacturer's standard handrails meeting code requirements, of shape, metal, and finish indicated.

2.8 HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:

1. Stainless-Steel Frames: Formed from stainless-steel sheet.
2. Sight Guards: Provide sight guards on doors matching door edges.
3. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.9 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers or LEDs.

B. Car Control Stations: Provide manufacturer's standard recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.

C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 26 - ELECTRICAL.

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.

1. Include travel direction arrows if not provided in car control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group.

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide[one of] the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on each car.

I. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and direction of travel.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to operate elevator.

B. Check operation of each elevator with Owner’s personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION

SECTION 149313

FIREHOUSE SLIDE POLES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Fixed fire station sliding pole.
2. Landing mat assembly.
3. Accessories required for a complete installation, including but not limited to fasteners and anchors.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Division 26 - ELECTRICAL for wiring of fire pole.

1.3 SUBMITTALS

A. Product Data: For the following:
1. Sliding pole.
2. Landing mat.

B. Shop Drawings: Show fabrication and installation details for sliding pole assembly.

1. Include plans, elevations, sections, and details of sliding pole. Show anchorage and accessory items.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

A. Delegated Design: Design poles and miscellaneous framing and supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated for this Project in material, design, and extent.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

D. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide, the following:

1. McIntire Brass Works. Inc., Somerville, MA.
2. Or equal.

B. Basis-of-Design Products: McIntire Model 23 slide pole, motor-operated fire-resistant floor door, cage with guard rail and safety gate, ceiling plate, floor and ceiling flange and landing mat

2.2 SLIDING POLE SYSTEM COMPONENTS

A. Poles: Material: Hard drawn polished brass tubing, brass alloy C260.

1. Wall thickness: 5/32 inch.
2. Diameter: 2-1/2 inches.

B. Guard:

1. Manufacturer's standard cast bronze guard pipe and fittings with self-closing gate in chrome finish.
2. Manufacturer's standard 14-gauge stainless steel mesh guard infill panels

C. Floor Assembly: Polished cast bronze trim ring for the floor edge and ceiling with stainless steel filler sheet at floor penetration, and floor closure panels.

1. Automatic Shutter: Hinged aluminum shutter panels attached to ceiling ring.
2. Fire-Resistance Rated Door: Motor driven, paired steel door and frame.
   a. Provide manufacturer's self-contained electric enclosed control unit containing motor controllers and a programmable logic controller, drive motors, two infrared sensors, heat sensor as required for a complete operable assembly.

D. Landing Mat:

1. Material: Closed cell black neoprene, ASTM D1056: Grade 2C2-E1.
2. Diameter: 36 inches.
3. Thickness: 2 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Sliding pole, doors, guards and mat according to manufacturer’s instructions.

B. Coordinate with concrete floor construction, floor cylinder provided by slide pole manufacturer.

C. Install components plumb and level, accurately fitted, free from distortion or defects.

D. Install components plumb and level, accurately fitted, free from distortion or defects.

E. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

F. Provide welded field joints where specifically indicated on Drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

3.2 TOLERANCES

A. Maximum variation from plumb: 1/4 inch per story, non-cumulative.

3.3 FIELD QUALITY CONTROL

A. Remove, repair and reinstall, or restore-in-place damaged items prior to inspection for Substantial Completion.

1. Replace damaged materials and components with new if repair not acceptable to Architect.

3.4 PROTECTION

A. Protect installed work from subsequent construction operations until Substantial Completion.

END OF SECTION

SECTION 210000

FIRE PROTECTION
(Filed Sub-Bid Required)

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SECTION 210000

FIRE PROTECTION
(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 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. Time, Manner and Requirements for Submitting Sub-Bids:

1. 1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

   The following should appear on the upper left hand corner of the envelope:

   NAME OF SUB-BIDDER: (Insert name of sub-bidder)

   MASS. STATE PROJECT: ((Insert project number from top of page))

   SUB-BID FOR SECTION: 210000 – FIRE PROTECTION

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. The Work of this Section is shown on the following Drawings: FP001, FP100, FPFP101, FP102

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, services and accessories necessary to Design, Furnish and Install the work of this Section, complete and functional, as indicated in the Contract Documents and as specified herein. The Design shall conform to the documents and shall be subject to approval by the Architect.

B. Without limiting the generality thereof, the work to be performed under this Section includes:

1. A hydraulically designed combination sprinkler/standpipe system to provide 100% protection for the renovated existing building as noted on the Drawings. Refer to Fire Protection Criteria on the Drawings. Prepare Working Drawings for approval of the Architect, the local authority having jurisdiction, and the owner's insurance company under stamp of an independent Massachusetts Registered Professional Fire Protection Engineer.
2. Hydrant flow test

3. Pipe and Fittings
4. Valves
5. Hangers
6. Sprinkler Heads
7. Furnishing and installation of Supervisory Switches and Controls
8. Systems Identification
9. Flushing and Testing of the interior and exterior system as provided herein.
10. Drilling, Coring, Cutting & Patching of holes and openings (where the largest dimension thereof does not exceed 12 inches), for Fire Protection Piping and Equipment. All such holes require sleeves.
11. Scaffolding, Rigging, and Staging required for all Fire Protection Work. Comply with Division 1 requirements.
12. Provide Seismic Restraints for all Fire Protection Systems conforming to the requirements of Section 230548 which Section is herein incorporated by reference as work of the Fire Protection Sub Contractor. Seismic Restraints are required in both new and existing building.
13. Furnishing of Access Panels
14. The work is to be phased. The Fire Protection Subcontractor shall construct the Project in phases as directed by the Architect to suit the Project progress schedule, as well as the completion date of the Project. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the Architectural Drawings. Maintain the Fire Protection Systems in the various phases as they are occupied by the owner, and for the life of the Project. Every space whether new construction or renovation of existing building when occupied shall have a fully functional sprinkler system.
15. Demolition of existing piping and heads within the renovated areas of the project and performed in a manner to preserve the phasing schedule.
16. Smoke and Firestopping Seals and sealing of all wall penetrations as detailed on the drawings. Refer to Section 078410 which defines the firestopping materials and methods.
17. When open-flame or spark producing tools such as blower torches, welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain constant non-working fire watch through the Local Fire Department where work is being performed and until it is completed.
18. It is the responsibility of this fire protection contractor to provide skilled and properly licensed Sprinklerfitter Foreman, Journeyman, and Apprentices for each project. At any time when an unlicensed labor is found to be on the job, it is the sole responsibility of this fire protection contractor to replace these workers with properly licensed personnel immediately. Any and all work found to be incorrect, defective, installed in contrary to state, local or NFPA standards, regulations or good engineering practices, shall be expeditiously corrected without delay to the project schedule and at no additional cost to the Owner or General Contractor.

1.3 RELATED WORK

A. The following items of work related to the Fire Protection Work are included under other Sections of the Specifications:

1. Cutting & Patching beyond 1.2B.10 above: SECTION 017329 - CUTTING AND PATCHING.
2. Installation of Access Panels: Respective finish section.
3. Finish Painting: SECTION 099000: PAINTING AND COATING
4. Wiring for Supervisory Switches, Electrical Alarm, and Flow Switches, and Power Wiring:

SECTION 260000 - ELECTRICAL
5. Temporary Facilities: SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS
6. Installation of Hood Suppression System – SECTION 113100 APPLIANCES

1.4 CODES, ORDINANCES, AND PERMITS

A. Perform all work in accordance with the following Codes:

1. 780 CMR: The State Building Code.
2. 527 CMR: The Fire Prevention Regulations.
3. NFPA-13-2013, NFPA-14-2013, NFPA-24-2013, NFPA 25-2014, NFPA-241-2022, and Owner's insurance company requirements.
4. All applicable Local, State, and Federal Codes, Statutes, or Regulations.
5. Town of North Reading Fire Department.
6. Town of North Reading Building Department.

B. Obtain all permits, inspections, and approvals, from the governing authorities and pay all fees and include cost in the bid, including approvals for the cross connection control device. Provide the Owner with the cross connection permit for the device in the Owner's name.

1.5 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, advise Designer in writing before Award of Contract. Otherwise, Designer's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or unclarities thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Designer in writing before installation. Otherwise, make changes in installed work as Designer requires within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, this contractor shall provide that material, installation, or work which is of the higher standard.

D. It is the intent of these contract documents to have the contractor provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the contractor has failed to notify the Designer of the situation in accordance with the paragraph above, the contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. In cases covered by the paragraph above, where the contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Designer shall review, note if necessary, and approve the sketch.

1.6 MODIFICATIONS IN LAYOUT

A. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet architectural requirements.

B. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Designer.

C. Check Contract Drawings as well as Shop Drawings of all subcontractors to verify and coordinate spaces in which work of this Section will be installed.

D. Maintain maximum headroom at all locations. All piping and associated components to be as tight to underside of structure as possible.

E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C, D above. Systems shall be run in a rectilinear fashion.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Designer for review and approval.

1.7 RECORD DRAWINGS

A. General: Refer to DIVISION 01 - GENERAL REQUIREMENTS for general requirements for maintaining as-built drawings and submitting final reproducible record documents.

B. The General Contractor will provide two sets of black or blue line on white Drawings to the Fire Protection Subcontractor, one set of which shall be maintained at the site and which shall, at all times, be accurate, clear, and complete, showing the actual locations of all equipment and piping as it is being installed. The Record Drawings shall be available to the Architect/Engineer's field representative at all times.

C. Provide electronic AutoCAD drawings to indicate revisions to piping size and location both exterior and interior; including locations of valves and other equipment requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column line; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located.

D. Include in the Record Drawings any addenda, sketches, and supplementary Drawings issued during the course of construction.

E. Non-availability of Record Drawings or inaccuracies therein will postpone the final inspection until they are available.

F. All valves shown on these Drawings shall be numbered with numbers corresponding to those on the valve charts.

G. All costs related to the foregoing requirements shall be paid by the Fire Protection Subcontractor.

1.8 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Provide operating instructions to the owner's designated representative with respect to operation functions and maintenance procedures for all equipment and systems installed. At the completion of the project, turn over to the Architect four (4) complete manuals in three-ring, loose-leaf binders, containing the following:

1. Complete Shop Drawings of all equipment.

2. Operation description of all systems.
3. Names, addresses, and telephone numbers of all suppliers of the system.
4. Preventive maintenance instructions for all systems.
5. Spare parts list of all system components.
6. Service contracts or forms required after occupancy.
7. Valve tag chart noting location of any and all valves controlling the fire protection systems including main control, main drain, auxiliary drain, drum drip, inspectors test connections and any low point drains connected to these systems.
8. Copy of NFPA 25, latest edition.

B. Provide DVD recording of operation and maintenance training sessions and include as part of O & M Manual submittal. Training session video recording and DVDs shall be performed by a professional videographer. Provide indexed table of contents for DVD recording.

C. Both O&M's and training Videos shall be saved on BMS server and provide a Control page weblink to O&Ms and Training videos.

1.9 SHOP DRAWINGS AND MATERIAL SCHEDULES

A. Refer to SECTION 013300 – SUBMITTAL PROCEDURES for substitution of equipment and submittal of Shop Drawings. If apparatus or materials are substituted for those specified, and such substitution necessitates changes in or additional connections, piping, supports or construction, same shall be provided as the responsibility, and at the expense, of the Fire Protection Subcontractor.

B. Fabrication of any material or performing of any work prior to the final approval of the Submittals will be entirely at the risk of the Subcontractor. The Subcontractor is responsible for furnishing and installing materials called for in the Contract Documents, even though these materials may have been omitted from approved Submittals.

C. Submit Shop Drawings for the following materials and equipment.

1. Coordinated Working Drawings and hydraulic calculations including size, type, length, temperature rating of sprinkler heads, piping and the like. Indicate flow test results, design criteria, hydraulic reference points, diffuser and light locations.
2. Access Panels and Covers
3. Sprinkler Heads
4. Hangers and Seismic Restraints
5. Pipe, Fittings, and Appurtenances
6. Systems Identification
7. Valves

1.10 COORDINATION DRAWINGS

A. Before materials are purchased or Work is begun, prepare and submit to the Architect, Coordination Drawings showing the size and location of all equipment and piping lines relevant to the complete system. Ensure that these Drawings are compatible and correctly annotated and cross-referenced at their interfaces.

B. Coordination Drawings are for the Contractor's and the Architect's use during Construction and shall not be construed as replacing any Shop or Record Drawings required elsewhere in these Contract Documents.

C. Detailed procedures for Coordination Drawings are contained in DIVISION 01 of these Contract Documents.

1.11 GUARANTEE

A. Guarantee all work under this Section free from defects in workmanship or materials for a period of one (1) year from the date of final acceptance of the building, as set forth in the Contract.

B. Replace any such defective work developing during this period, unless such defects are clearly the result of bad usage of equipment by others. Where such defective work results in damage to work of other Sections of the Specifications, restore such work to its original condition by mechanics skilled in the affected trade.

1.12 DRAWINGS

A. All work shown on the Drawings is intended to be approximately correct to scale but shall be taken in a sense as diagrammatic. Sizes of pipes and general method of running them are shown, but it is not intended to show every offset and fitting. To carry out the true intent and purpose of the plans, furnish all necessary parts to make a complete working system ready for use.

B. The Drawings and Specifications are intended to supplement each other so that any details shown on the Drawings and not mentioned in the Specifications, or vice-versa, shall be executed the same as if mentioned in the Specifications and shown on the Drawings.

C. Refer to the Architectural, Structural, and Other Mechanical and Electrical Drawings which indicate the construction in which this work shall be installed. Locations shown on the plans shall be checked against the general and detailed drawings of the construction proper. All measurements must be taken at the building.

1.13 SYSTEM DESCRIPTION

A. The existing building is protected with a combined standpipe/sprinkler system. The existing wet type sprinkler system shall be demolished in the proposed work area. The existing dry system protecting the existing unheated attic above the second floor shall remain active. The existing standpipe in the renovated area stairwell shall remain. The new addition and renovated areas are to be 100% sprinklered with an automatic wet type sprinkler system. The automatic sprinkler system shall be designed in accordance with NFPA-13-2013.

B. Building is to be 100% sprinklered including all closets regardless of size, all Electric rooms and Emergency Electric rooms. The elevator shaft and elevator machine room are not sprinklered.

C. Refer to Fire Protection Criteria on the Drawings. Conform to the zoning shown on the plans.

D. Locations of sprinkler heads are shown in some of the areas to be sprinklered only to establish the patterns and design intent. Major equipment and runs of piping may also be shown. Refer to reflected ceiling plan for location of all sprinkler heads. All sprinkler heads are to be installed dead center of tile.

E. The documents require that the building be covered 100%. This includes all closets, combustible concealed spaces, and other areas as required under NFPA-13-2013. These areas are to be included in the Sub-contractor's bid whether or not the heads are shown on the sprinkler plans.

1.14 ALARM FACILITIES

A. Furnish and install all Supervisory Switches, Flow Switches, Pressure Switches, and other Alarm Devices. Install all such devices on the piping and coordinate with the Electrical Subcontractor who shall wire all such devices to the Fire Alarm System. Every shutoff valve installed on this project shall have a supervisory trouble switch wired to the Fire Alarm Panel.

1.15 PIPE MARKER IDENTIFICATION SYSTEM

A. Mark all piping installed under this Section with a marking system in basic colors conforming to those specified in ANSI/ASME A-13.1. Markings shall indicate pipe content and direction of flow. Apply markers every 20 feet on center on piping which is exposed in mechanical or storage areas and above suspended accessible ceilings. Also, apply at all access panels, valves, tee joints, alarms, and/or controls.

B. Adhesive system may be used throughout except at the mechanical rooms in which case markings shall be painted on.

1.16 VALVE TAGS

A. All valves installed in the Fire Protection Contract shall be tagged. Tags shall be secured to valves with chain link and shall be marked with 3/4 inch high letters as to function. All valve tags shall indicate the Fire Zone.

B. A corresponding framed Valve Tag Chart shall be installed within each Sprinkler Riser or Control Valve Room indicating location of each valve and the section it serves. This chart shall also be included within the Owner's O&M Manual with valve tag locations noted on the As-Built Sprinkler drawings.

1.17 IDENTIFICATION SIGNS

A. All equipment and systems shall be identified with signs furnished and attached in accordance with NFPA 13.

1.18 PAINTING

A. All interior exposed piping is to be painted and all painting, except as noted, will be done by the Painting Subcontractor. All uncovered piping and hangers shall be thoroughly cleaned of rust, oil, and other containments by the Fire Protection Subcontractor and left ready to receive primer coat.

B. Painting for pipe markings shall be done under this Section.

1.19 DEMOLITION

A. When and as directed by the General Contractor perform all demolition work.

B. Remove as indicated existing piping, heads, and equipment including all hangers and supports.

C. In cases where main piping is to remain, remove all existing piping being removed and cap said piping back to riser or main. All caps or plugs to be installed shall be of like material as pipe being capped or plugged.

D. All piping, valves, hangers, and fittings shall be removed as indicated and placed on the floor by this Section. The General Contractor shall remove from the floor and dispose.

E. Any disputes between this Subcontractor and other Contractors or Subcontractors relative to the responsibility for removal of equipment shall be referred to the Architect for decision. The Architect's decision shall be firm and binding and to whomever he designates responsibility for removal of equipment shall do so without any additional cost to the Owner.

1.20 HOISTING EQUIPMENT AND MACHINERY

A. Unless otherwise specified, all hoisting and rigging equipment and machinery required for the proper and expeditious prosecution and progress of the Work of this Section shall be furnished, installed, operated and maintained in safe condition by each sub-contractor, as specified under Section 015000, TEMPORARY FACILITIES AND CONTROLS.

1.21 STAGING AND SCAFFOLDING

A. Unless otherwise specified, each sub-contractor shall provide all lifts and man-lifts, and furnish, erect and maintain in safe condition, all staging and scaffolding as specified under Section 015000 Temporary Facilities and Controls, as needed for proper execution of the work of this Section. Staging and scaffolding shall be of adequate design, erected and removed by experienced stage builders having all accident prevention devices required by Federal, state and local laws.

1.22 BREAKDOWN

A. Submit a breakdown of the contract price to aid the Architect in determining the value of the work installed as the job progresses.

B. No requisition will be approved until the breakdown is delivered to the Architect.

1.23 VISIT TO SITE

A. Prior to submitting a bid, visit the site of work and become familiar with existing conditions at the site of the work. Any assumptions made are at this Subcontractor's expense.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished under this Section shall be new, unused, first quality of a manufacturer of established reputation and shall be U.L./F.M. approved. Each valve, fitting, section of pipe, and piece of equipment shall have cast or indelibly stamped thereon the manufacturer's name and pressure rating where applicable. All threads for fire department connection shall conform to the standards of the Local Fire Department.

2.2 PIPE AND FITTINGS

A. Pipe and fittings shall conform to the latest A.S.A., A.S.T.M., C.A., and F.S. Standards. All grooved products shall be of one manufacturer to conform to NFPA Standards.

B. All piping installed under this Section shall be in accordance with the following:

Service	Materials
Sprinkler piping 1-1/2 inch and smaller	ASTM A-53, Schedule 40 black steel pipe
Sprinkler and standpipe piping 2 inch and larger	Schedule 10, ASTM A-135 U.L./F.M. black steel pipe

C. Fittings on fire line piping, 2 inch and larger, shall be Victaulic Fire Lock Ductile Iron Fittings conforming to ASTM A-536 with integral grooved shoulder and back stop lugs and grooved ends for use with Style 009-EZ or Style 005 couplings.

D. Fittings for standpipes and risers, 2-1/2 inch and larger, and where ever required to conform to Seismic Requirements shall be Victaulic Vic-Flex Style 75 or 77 with Fire Lock Gasket.

E. Branch line fittings shall be welded or shall be Victaulic 920/920N Mechanical Tees.

F. Schedule 10 pipe shall be roll grooved. Schedule 40 pipe where used with mechanical couplings shall be rolled groove and shall be threaded where used with screwed fittings.

G. Fittings for threaded piping shall be malleable iron screwed sprinkler fittings.

H. All pipe and fittings shall be U.L./F.M. approved for sprinkler and standpipe service. All pipe and fittings shall be galvanized for dry or pre-action system and black for wet system.

I. Grooved fittings shall be manufactured by Victaulic, Grinnell, Anvil, or equal.

2.3 JOINTS

A. Threaded pipe joints shall have an approved thread compound applied on male threads only. Teflon tape shall be used for threads on sprinkler heads.

B. Joints on piping, 2 inch and larger, shall be made up with Victaulic, or equal, Fire Lock Style 005, rigid coupling of ductile iron and pressure responsive gasket system for wet or dry sprinkler system as recommended by manufacturer. Couplings on dry systems shall be galvanized. Cutting, roll grooving, lubrication, and assembly of all joints shall be made strictly in accordance with manufacturer's recommendations. Exercise particular caution in the use of lubricant to avoid “squeeze out” of lubricant when system is in service.

C. Grooved joints and fittings shall be manufactured by Victaulic, Grinnell, Anvil, or equal.

D. Furnish and install where piping crosses building expansion joints a listed expansion joint. Expansion joints shall be Metraflex "Fireloop", or manufactured by Flexonic Company or Hyspan, or equal. Expansion joints shall be UL approved for use for fire sprinkler systems.

2.4 VALVES

A. All shutoff and control valves shall be U.L./F.M. approved, indicating type valves equipped with a supervised trouble switch wired to the fire alarm system. Shutoffs and zone valves may be either OS&Y indicating gates or butterfly valves.

B. Gate valves shall be outside screw and yoke indicating type, 175 psi W.P. and U.L./F.M. listed, Jenkins or equal. All such valves shall have supervised trouble switch.

C. Butterfly valves shall be Victaulic Series 705-W for 2-1/2 inch and larger, and Milwaukee indicating type U.L./F.M. butterball for threaded service. Coordinate with Electrical Sub-contractor to have factory installed monitor switches compatible with the remainder of the Fire Alarm System.

D. Check valves shall be iron body bronze mounted U.L./F.M., 175# W.P. or U.L./F.M. wafer checks. Grooved end valves shall be Victaulic Style 717 Fire Lock Check Valve.

E. Pressure relief valves shall be located on wet systems pressure regulating valves and downstream of check valves per NFPA-13-2013. Pressure relieve valves shall be listed and not less than 1/2 in. in size and shall be by AGF, Watts, Cla-Val or equal.

F. Ball drips shall be Potter Roemer #5682, 3/4 inch straight design ball drip valve, or by Victaulic, Viking, or equal.

G. Drains shall be provided in the systems as may be required by field conditions. Provide drains at all low points and wherever necessary to insure that all portions of the sprinkler piping may be completely drained. Test connections shall be provided as required to test all portions of the system. Pipe low point drains and test connections to suitable receptor as determined in field or shown on Drawings.

H. Install an inspector's test connection at the furthest point of each sprinkler zone. Run discharge back to a suitable receptor. Exterior wall penetration is permitted with test drain but only as approved by the Architect.

I. Valves shall be manufactured by Victaulic, Nibco, Viking, or equal. Inspector’s test stations shall be manufactured by AFG, Tyco, Victaulic, or equal.

2.5 SPRINKLERS

A. All sprinklers to be used on this project shall be Quick Response type and shall be stamped with date of manufacture and temperature rating. Temperature ratings shall be determined by the location of the heads per NFPA 13-2013, section 8.3.2.5, and shall be minimum 155 degrees F. throughout except in special areas around heat producing equipment, skylights, and attics in which case use temperature rating to conform with hazard as specified in NFPA 13-2013. Orifice diameter and K factor shall be appropriate to meet the hydraulic design criteria, the available water supply, and NFPA Standards.

B. Furnish spare heads of each type installed located in a cabinet along with special sprinkler wrenches. The number of spares and location of cabinet shall be in complete accord with NFPA 13-2013.

C. Sprinklers shall be manufactured by Tyco, Victaulic, Viking, or equal.

D. Upright sprinkler heads in areas with no ceilings shall be Tyco Model "TY-FRB" Quick Response, upright natural brass finish heads. Include heavy duty sprinkler guards on all upright sprinkler heads.

E. Sidewall heads shall be Tyco Model "TY-FRB" Quick Response with white polyester head and escutcheon.

F. Pendent wet sprinkler heads shall be Tyco Model "TY-FRB" Quick Response recessed adjustable escutcheon, white polyester finish.

G. Concealed heads shall be Tyco Model "RFII" Quick Response concealed type, 1-1/2 inch adjustment white cover plate. In special areas, as may be noted on the Drawings, provide alternate cover plate finishes.

H. Dry pendent sprinkler heads shall be Tyco Model "DS-1" Quick Response dry type, white polyester finish, and white escutcheon.

I. Dry sidewall sprinkler heads shall be Tyco Model "DS-1" dry horizontal sidewall heads, white polyester finish, and white escutcheon.

J. Sprinkler heads located in concealed combustible spaces shall be Tyco Model "CC2" upright sprinkler head, natural brass finish.

K. Use of flexible stainless steel hose with fittings for fire protection service that connect sprinklers to branch lines in suspended ceilings is acceptable. Flexible hoses shall be UL/FM approved and shall comply with NFPA 13 standards. Hose assemblies shall be type 304 stainless steel with minimum 1-inch true-bore internal hose diameter. Ceiling bracket shall be galvanized steel and include multi-port style self-securing integrated snap-on clip ends that attach directly to the ceiling with tamper resistant screws.

2.6 FIRE STANDPIPE EQUIPMENT

A. Fire Department Valves shall be Croker Series 5015 Fire Department Valves fitted with 2-1/2 inch x 1-1/2 inch reducer, caps and chains all conforming to Local Fire Department thread standard. Valves shall be polished chrome plated and shall be mounted in a recessed cabinet as indicated on Drawings.

B. Valves shall be manufactured by Croker, Potter Roemer, Elkhart, or equal.

2.7 SUPPLEMENTARY STEEL, CHANNEL, AND SUPPORTS

A. Furnish and install All Supplementary Steel, Channels, and Supports required for the proper installation, mounting, and support of all equipment.

B. Supplementary Steel and Channels shall be firmly connected to building construction in a manner approved by the Architect.

C. The type and size of the Supporting Channels and Supplementary Steel shall be determined by the Fire Protection Subcontractor and shall be sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

D. All Supplementary Steel and Channel shall be installed in a neat and workmanlike manner parallel to the walls, floor, and ceiling construction. All turns shall be made with 90 degree fittings, as required to suit the construction and installation conditions.

2.8 HANGERS AND SEISMIC RESTRAINTS

A. Hangers shall be furnished, installed, and supported from the building structure in accordance with NFPA - 13, Section 230548 and Drawing VS-1.

B. All installed piping whether in new or existing building shall be seismic restrained.

C. Hangers shall not be installed directly into the roof deck. Provide supplementary steel per paragraph 2.7 above as required to support piping from structure.

2.9 ALARM DEVICES

A. Flow switches shall be vane type water flow detectors with 0-90 Sec. Adjustable non-accumulative retard device and (2) single pole double throw contacts, Notifier Series WFD Potter, VSR.F or equal. At base of standpipe risers, flow switch shall be a non-water discharge, auto-test vane type water flow detector with 0-90 second adjustable non-accumulative retard device and (2) single pole double throw contacts, Potter VSR.AT or equal. The flow switch shall be paired with either a single gang box test switch, Potter ATC-1 for testing a single device or ATC-4 for testing up to four devices."

B. Supervisory switches on all O.S. & Y. gate valves shall be Notifier NGV complete with mounting bracket.

C. Refer to Drawings for additional devices. Co-ordinate, prior to ordering devices, with the Electrical Sub-Contractor to assure device compatibility with the Fire Alarm System.

D. Flow, pressure and supervisory switches shall be manufactured by Potter, Notifier, System Sensor, or equal.

2.10 ACCESS DOORS

A. Furnish Access Doors for access to all concealed control valves, drains, inspector's tests, supervisory devices, and to all other concealed parts of the system that require accessibility for the proper operation and maintenance of the system. These doors shall be installed under the appropriate Section of the Specifications for the surface upon which the panels are mounted.

B. All Access Doors shall be located in a workmanlike manner in closets, storage rooms, and/or non-public areas, positioned so that the valve or part can be easily reached, and the size shall be sufficient for this purpose (minimum size 12 inch x 16 inch). When access doors are required in corridors, lobbies, or other habitable areas, they shall be located as directed by the Architect.

C. Refer to Section 083110 - Access Doors and Frames, for all product requirements for furnishing access panels.

D. Coordinate locations and schedule with the work of trades involved with construction in which access panels will be installed.

E. Access Door Shop Drawings shall be submitted to the Architect for approval.

F. All access panels shall be keyed alike. Coordinate keying with other trades.

2.11 FIRESTOP SYSTEMS

A. General: Provide firestopping at all new fire-rated construction where penetrated by the Work of this Section.

B. Refer to Section 078410 - Firestopping, for all product requirements for maintaining integrity of fire-rated construction at penetrations.

2.12 SCAFFOLDS AND STAGING

A. General: Trade Contractors shall obtain required permits for, and provide scaffolds, staging, and other similar raised platforms, required to access their Work as specified in Section 01 50 00 - Temporary Facilities and Controls and herein.

1. Scaffolding and staging required for use by this Trade Contractor pursuant to requirements of Section 01 50 00 - Temporary Facilities and Controls shall be furnished, erected, maintained in a safe condition, and dismantled when no longer required, by this Trade Contract requiring such scaffolding.
2. Each Trade Contractor is responsible to provide, maintain and remove at dismantling, all tarpaulins and similar protective measures necessary to cover scaffolding for inclement weather conditions other than those required to be provided, maintained and removed by the General Contractor pursuant to MGL (Refer to Section 01 50 00 - Temporary Facilities and Controls and as additionally required for dust control).
3. General Contractor is responsible to provide enclosures required for temporary heat; refer to Section 01 50 00 - Temporary Facilities and Controls.

a. Furnishing portable ladders and mobile platforms of all required heights, which may be necessary to perform the work of this trade, are the responsibility of this Trade Contractor.

2.13 HOISTING MACHINERY AND EQUIPMENT

A. All hoisting equipment, rigging equipment, crane services and lift machinery required for the work by this Trade Contractor shall be furnished, installed, operated and maintained in safe conditions by this Trade Contractor, as referenced under Section 01 50 00 - Temporary Facilities and Controls.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION METHODS

A. All work shall be installed in a first-class manner consistent with the best current trade practices. All materials shall be securely installed plumb and/or level, and all flush mounted equipment shall have front edge flush with finished wall surface.

B. Protect all concealed heads. Coordinate and advise finishing trades so as to prevent painting of sprinkler heads or inadvertent filling with paint or jointing compound of required air spaces in the case of the concealed type sprinkler heads.

C. Training:

1. Train the Owner's maintenance personnel on troubleshooting procedures, and servicing and preventative maintenance schedules and procedures.
2. Schedule training with Owner through the Architect with at least 7 days prior notice.

3.2 WORK COORDINATION AND JOB OPERATIONS

A. The equipment shall not be installed in congested and possible problem areas without first coordinating the installation of same.

B. Before materials are purchased or work is begun, prepare and submit to the Architect, Coordination Drawings showing the size and location of all equipment and piping lines relevant to the complete system. Ensure that these Drawings are compatible and correctly annotated and cross-referenced at their interfaces.

C. Coordination Drawings are for the Contractor's and the Architect's use during construction and shall not be construed as replacing any Shop or Record Drawings required elsewhere in these Contract Documents.

D. Detailed procedures for Coordination Drawings are contained in DIVISION 01 - GENERAL REQUIREMENTS of these Contract Documents.

E. Particular attention shall be directed to the coordination of piping and other equipment installed in the ceiling areas. Coordinate the elevations of all piping in hung ceiling areas to insure adequate space for the installation of recessed lighting fixtures before other mechanical equipment is installed.

F. Furnish to the General Contractor, and all other Subcontractors, all information relative to the portion of the Fire Protection installation that will affect them, sufficiently in advance so that they may plan their work and installation accordingly.

G. In case of failure to give proper information as indicated above, sufficiently in advance, pay for all back-charges for the modification, renovation, and relocation of any portion of the work already performed.

H. Obtain from the other trades, all information relative to the Fire Protection Work to be executed in conjunction with the installation of their respective equipment.

3.3 CUTTING AND CORE DRILLING

A. Perform all cutting and core drilling operations that are outlined in Part 1 of this SECTION. Throughout the performance of the cutting and coring work, ensure that the structural integrity of the walls, floors, overhead structure, and other structural components is maintained until permanent work is installed. Prior to any coring or cutting, verify all locations of same with the General Contractor. All cutting and coring is to be performed in accordance with approved Coordination Drawings.

B. Cut all masonry and concrete with an approved diamond blade concrete saw in a neat straight direction, perpendicular to the plane of the wall or floor.

C. Use a core drilling process which produces clean, sharp edges and the minimum hole size which will accommodate the size of pipe sleeve specified.

D. Patch all holes up to the sizes indicated in this Section with material and methods as are specified in the Section of the Specifications for the finish trade involved. Holes which are improperly done due to poor materials or method, shall be patched to the satisfaction of the Architect by the finish trade and back-charged to this Subcontractor.

3.4 CLEANING AND PROTECTION

A. Protect all materials and equipment during shipment and installation and properly handle and store at the job site so as to prevent damage. Assume full responsibility for protection of work until its completion and final acceptance.

B. Keep the premises reasonable clean at all times and remove rubbish caused by the Fire Protection work as directed by the Architect.

C. Upon completion of this work, clean all sprinklers, and equipment and replace damaged parts. Failure to fulfill this obligation will result in back-charges for correction of the defective work by others.

3.5 SLEEVES, INSERTS, AND ESCUTCHEONS

A. All piping passing through slabs, floors, walls, and partitions shall be sleeved and all such sleeves shall be furnished and installed by the Fire Protection Subcontractor as detailed on the Drawings and herein specified. Fire Protection Contractor, shall do his core drilling as approved by the Architect and the cored opening shall have a sleeve caulked and leaded in place. Set sleeves in concrete floors and walls as soon as forms set and before concrete is poured.

B. All pipes passing through floor, whether slab-on grade or above grade levels shall be sleeved with sleeve extending 1 inch above floor. This includes all piping in toilet room pipe space, stairwells, closets, and partitions. In mechanical penthouses, pipe sleeves shall extend 4 inches above floor.

C. All sleeves shall be Schedule 40 galvanized steel pipe and shall be reamed. There shall be annular space between the sleeve and pipe per NFPA requirements. Sleeves on drywall, masonry, or concrete walls and partitions shall be flush with wall on both sides.

D. The space between sleeve and pipe, in all cases, shall be filled with U.L./F.M. approved caulking compound. This includes pipes concealed in chases and/or partitions.

E. Inserts, where required, shall be furnished and set by the Fire Protection Subcontractor and, where necessary, may be drilled or power driven and shall be sized such that the insert will not exceed a depth of penetration of 1 inch into concrete.

F. Escutcheons: All exposed pipe, uncovered, passing through walls, or floors, or ceilings, shall be fitted with C.P. brass spun or split type escutcheons with approved clamping device for holding in position. Floor escutcheons shall be deep enough to fit over sleeves, fastened to pipe, and extend down to floor.

3.6 TESTING

A. Flush the system and test all work in the presence of the Architect and/or Engineer and as required by NFPA and the Insurance Company. The flushing and testing procedures to be followed are specified herein. At the completion of the testing, submit fully executed copies of Contractor's Material and Test Certificate for both above ground and underground piping as contained in NFPA-13.

1. Sprinkler System:

a. Hydrostatic Testing: The interior system shall be hydrostatically tested at 200 psi for 2 hours in accordance with NFPA 13 paragraph 25.2.1.
b. Operational Testing: Water flow switches and associated alarm systems shall be tested by water flow through the inspectors test assemblies in accordance with NFPA 13, 25.2.3.
c. Main Drain Test: A flow test shall be performed on the main drain valve and recorded on the Contractor’s test certificate in conformance with NFPA 13, 25.2.3.4.

d. Backflow Preventor Flow Test: The double check valve assembly shall be flow tested in conformance with NFPA 13, 25.2.5. Provide piping and or valving arrangement to preform full flow testing of backflow device.
e. Dry system shall be trip tested and acceptance tested with recorded results submitted to the owner for their review and record in accordance with NFPA 13 and 25. All dry systems shall be completely drained with all water removed prior to being placed in permanent service.
f. Underground Piping: Underground piping and fire sprinkler lead in connections to each building shall be hydrostatically tested, flushed and chlorinated in accordance with NFPA 24, the Local DPW, and any other pertinent laws or governing standards. Flushing, Testing and chlorination reports shall be given to the owner for review and included in the O&M Manuals for the fire protection systems.

2. Standpipe or Bulk Fire Main:

a. Flushing: The fire department connection piping shall be flushed at a minimum velocity of 10 fps in conformance with NFPA 13, and NFPA 14.
b. Hydrostatic Testing: All piping shall be pressure tested at 200 psi for 2 hours in conformance with NFPA 14.
c. Flow Tests: The system shall be flow tested at the hydraulically most remote hose connection in conformance with NFPA 14.
d. Valve and Supervisory Switch Test: All valves and tamper switches will be tested by opening and closing valves in conformance with NFPA 14.

3.7 FIRESTOP SYSTEMS:

A. General: Install firestop systems at all new fire-rated construction where penetrated by the Work of this Section.

B. Refer to Section 078410 – Penetration Firestopping, for all installation requirements for maintaining integrity of fire-rated construction at penetrations.

3.8 SEISMIC RESTRAINTS

A. The independent engineer responsible for design of seismic restraints shall visit the project upon completion of the work to certify the installation is consistent with the approved shop drawings. The certification shall be submitted to the Architect and must precede the closing in of ceilings.

3.9 SYSTEM SHUTDOWNS

A. Coordinate shutdowns of existing systems with the Owner and submit a written request at least ten working days in advance. Minimize system shutdowns as much as possible. Submit a list of all affected areas, the proposed work to be performed, and the expected length of the shutdown including time for retesting.

B. Provide temporary services to maintain active system during extended shutdowns as required for demolition and construction phasing.

END OF SECTION

SECTION 220000

PLUMBING
(Filed Sub-Bid Required)

PART 1 - GENERAL 1

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SECTION 220000

PLUMBING
(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 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. Time, Manner and Requirements for Submitting Sub-Bids:

1. 1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

   The following should appear on the upper left hand corner of the envelope:

   NAME OF SUB-BIDDER: (Insert name of sub-bidder)

   MASS. STATE PROJECT: ((Insert project number from top of page))

   SUB-BID FOR SECTION: 220000 – PLUMBING

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements:

Class of Work	Section Number
Insulation	2.5

D. The Work of this Section is shown on the following Drawings: P001, P002, P100, P101, P102, P103, P104.

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indicated in the Contract Documents and as specified herein.

B. The work covered by this Section of the Specifications includes the furnishing of all labor and materials and in performing all operations in connection with the installation of the Plumbing Work.

C. Without limiting the generality thereof, the work to be performed under this Section includes:

1. Complete Sanitary, Waste & Vent System to point of connection to existing within building and/or as shown on the drawings.
2. Storm drainage to 10 ft. outside foundation wall.
3. Garage waste and vent system including holding tank and alarms.
4. Potable Cold, Hot, and Hot Water Re-circulation System.
5. Non-Potable Cold, Hot, and Hot Water Re-circulation System.
6. Natural Gas System.
7. Air Compressor and compressed air piping system.
8. Insulation.
9. Domestic Water Heating Equipment.
10. Fixtures and Equipment
11. Connection to Equipment Furnished by Others
12. Flushing, Sterilization, and Tests
13. Furnishing of Access Panels
14. Drilling, Coring and Cutting & Patching of holes and openings where the largest dimension thereof does not exceed 16 inches for Plumbing Piping and Equipment.
15. Demolition of existing Plumbing Equipment and Disconnecting, Capping, and otherwise making inactive, all existing Plumbing Services in the various areas where Demolition and Removal Work is required; and removing, relocating, and reinstalling existing Plumbing items to the extent specifically noted in the documents. Remove all piping hangers and equipment in accordance with the description in paragraph 1.20. Demolition work for the existing fire station shall consist of “Make Safe”, with the exception of the Lower Level garage drainage system.
16. Scaffolding, Rigging, and Staging required for all Plumbing Work. Comply with Division 1 requirements.
17. Provide Seismic Restraints for all Plumbing Systems conforming to the requirements of Section 230548 which Section is herein incorporated by reference. Seismic restraints are required on all new systems whether in new or existing building.
18. Preparation of Co-ordination Drawings.
19. Smoke and Firestopping Seals and sealing of all wall and floor penetrations as detailed on the drawings. Refer to Section 078410 which defines the firestopping materials and methods.
20. At Project close out the Plumbing Sub-Contractor shall provide the services of an outside firm who shall run an underground video camera, locating all drainage system lines including depth, preparing a video and identifying & correcting any problem areas. The Plumbing Sub-Contractor shall rod-out and power wash all underground drainage systems. Turn over 4 copies of the video and written report to the owner. Videos are required for the underground sanitary and garage waste, main lines. Branches are not required.
21. When open-flame or spark producing tools such as blower torches, welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain constant non-working fire watch, paying all fees, where work is being performed and until it is completed. Fee for fire watch shall be included in the bid.

1.3 RELATED WORK

A. The following Related Work will be performed under the designated Sections:

1. Cutting and Patching beyond 1.2C.14 above: SECTION 017329 - CUTTING AND PATCHING
2. Installation Of Roof Drains, Flashing for vents through roof: SECTION 076200 – SHEET METAL FLASHING AND TRIM
3. Electric Power Wiring: SECTION 260000 - ELECTRICAL
4. HVAC Equipment: SECTION 230000 - HVAC
5. Excavation and Backfill: DIVISION 31 - EARTHWORK
6. Finish Painting: SECTION 099000 – PAINTING AND COATING
7. Installation of Access Panels: SECTION describing material in which panel is installed.
8. Toilet Room Accessories: SECTION 102800 - TOILET ACCESSORIES
9. Temporary Facilities: SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

1.4 CODES, ORDINANCES, AND PERMITS

A. Perform all work in accordance with the requirements of the Town of North Reading Building Department, Massachusetts State Plumbing and Fuel Gas Codes, D.E.P., A.D.A., NFPA, The Architectural Barrier Code, and applicable State and Federal Laws. Give all requisite notices, file all requisite plans, and obtain all permits required to perform all Plumbing Work. Where the Contract Documents indicate more stringent requirements than the above Codes and Ordinances, the Contract Documents shall take precedence.

B. Obtain all permits, inspections, and approvals, from the governing authorities and pay all fees and include cost in the bid, including approvals for the cross connection control device. Provide the Owner with the cross connection permit for the device in the Owner's name.

C. Owner will pay all related Gas Utility Company back charges.

1.5 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, advise Designer in writing before Award of Contract. Otherwise, Designer's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or unclarities thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Designer in writing before installation. Otherwise, make changes in installed work as Designer requires within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, this contractor shall provide that material, installation, or work which is of the higher standard.

D. It is the intent of these contract documents to have the contractor provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the contractor has failed to notify the Designer of the situation in accordance with the paragraph above, the contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. In cases covered by the paragraph above, where the contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Designer shall review, note if necessary, and approve the sketch.

1.6 MODIFICATIONS IN LAYOUT

A. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet architectural requirements.

B. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Designer.

C. Check Contract Drawings as well as Shop Drawings of all subcontractors to verify and coordinate spaces in which work of this Section will be installed.

D. Maintain maximum headroom at all locations. All piping and associated components to be as tight to underside of structure as possible.

E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C, D above. Systems shall be run in a rectilinear fashion.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Designer for review and approval.

1.7 SHOP DRAWING AND MATERIAL SCHEDULES

A. Refer to SECTION 013300 – SUBMITTAL PROCEDURES for submittal of Shop Drawings. If apparatus or materials are substituted for those specified, and such substitution necessitates changes in or additional connections, piping, supports or construction, same shall be provided as the responsibility, and at the expense, of the Plumbing Subcontractor.

B. Fabrication of any material or performing of any work prior to the final approval of the Submittals will be entirely at the risk of the Subcontractor. The Subcontractor is responsible for furnishing and installing materials called for in the Contract Documents, even though these materials may have been omitted from approved Submittals.

C. Submit Shop Drawings for the following materials and equipment.

1. Valves, Piping, couplings and Fittings
2. Fixtures, Drains and Equipment including Supports
3. Backflow Preventers
4. Access Panels and Covers
5. Insulation
6. Drains, and Hydro Mechanical Specialties
7. Hose Bibs, Wall Hydrants
8. Hangers, Anchors, Guides, and Supports including Seismic Restraints
9. Cleanouts
10. Piping Identification System
11. Water Heating Equipment
12. Air Compressor
13. Sewage ejector and control panel

14. Elevator sump pump and control panel
15. Holding Tank and control panel.

1.8 COORDINATION DRAWINGS

A. Before materials are purchased or Work is begun, prepare and submit to the Architect, Coordination Drawings showing the size and location of all equipment and piping lines relevant to the complete system. Ensure that these Drawings are compatible and correctly annotated and cross-referenced at their interfaces (match lines).

B. Coordination Drawings are for the Contractor's and the Architect's use during Construction and shall not be construed as replacing any Shop or Record Drawings required elsewhere in these Contract Documents.

C. Detailed procedures for Coordination Drawings are contained in DIVISION 01 - GENERAL REQUIREMENTS of these Contract Documents.

1.9 RECORD DRAWINGS

A. General: Refer to DIVISION 01 - GENERAL REQUIREMENTS for general requirements for maintaining as-built drawings and submitting final reproducible record documents.

B. The General Contractor will provide two sets of Drawings to the Plumbing Subcontractor, one set of which shall be maintained at the site and which shall, at all times, be accurate, clear, and complete, showing the actual locations of all equipment and piping as it is being installed. The Record Drawings shall be available to the Architect/Engineer's field representative at all times.

C. Provide electronic AutoCAD drawings to indicate revisions to piping size and location both exterior and interior; including locations of valves and other equipment requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column line; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located.

D. Include in the Record Drawings any addenda, sketches, and supplementary Drawings issued during the course of construction.

E. Non-availability of Record Drawings or inaccuracies therein will postpone the final inspection until they are available.

F. All valves shown on these Drawings shall be numbered with numbers corresponding to those on the valve charts.

G. All costs related to the foregoing requirements shall be paid by the Plumbing Subcontractor.

1.10 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Provide operating instructions to the Owner's designated representative with respect to operation functions and maintenance procedures for all equipment and systems installed. At the completion of the project, turn over to the Architect four (4) complete manuals, in three-ring, loose-leaf binders, containing the following:

1. Complete Shop Drawings of all equipment.
2. Operation description for all systems.
3. Names, addresses, and telephone numbers of all suppliers of the system.

4. Preventative maintenance instructions for all systems.
5. Spare parts lists of all system components.
6. Four copies of video of below slab piping.
7. Valve tag chart.
8. Provide USB Drive with electronic copies of Items 1-7 above.

B. Provide USB Drive recording of operation and maintenance training sessions and include as part of O & M Manual submittal. Training session video recording and USB Drives shall be performed by a professional videographer. Provide indexed table of contents for USB Drive recording.

C. Both O&M's and training Videos shall be saved on BMS server and provide a Control page weblink to O&Ms and Training videos.

1.11 GUARANTEE

A. Refer to Division 1 of the Contract. Guarantee all work under this Section free from defects in workmanship and materials for a period of one (1) year from the date of final acceptance of the building, as set forth in the Contract. Replace any such defective work developing during this period, unless such defects are clearly the result of bad usage of equipment by others. Where such defective work results in damage to work of other Sections of the Specifications, restore such work to its original condition by mechanics skilled in the affected trade.

1.12 DRAWINGS

A. All work shown on the Drawings is intended to be approximately correct to scale, but shall be taken in a sense as diagrammatic. Sizes of pipes and general method of running them are shown, but it is not intended to show every offset and fitting. To carry out the true intent and purpose of the plans, furnish all necessary parts to make complete working systems ready for use. The Plumbing Drawings are intended to show the main stacks and risers and may or may not necessarily show all runout piping particularly in lavatories and gang toilet areas. Contractor shall include all runout piping to all referenced scheduled fixtures and equipment appearing on the Plumbing Drawings.

B. All floor drains installed on this project, including all kitchen floor drains and trough drains, shall be equipped with trap primers. The trap primer and piping is not shown on the drawings and shall be located in the field by the Contractor as dictated by field piping conditions.

C. The Plumbing Drawings and Specifications are intended to supplement each other so that any details shown on the Drawings and not mentioned in the Specifications, or vice-versa, shall be executed the same as if mentioned in the Specifications and shown on the Drawings.

D. Refer to the Architectural, Structural, and other Mechanical and Electrical Drawings, which indicate the construction in which this Work shall be installed. Locations shown on the plans shall be checked against the general and detailed Drawings of the construction proper. All measurements shall be taken at the Building.

1.13 VALVE TAGS, NAMEPLATES, AND CHARTS

A. All valves on pipes of every description shall have neat circular brass valve tags at least 1-1/2 in. in diameter attached with brass hook to each valve stem. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "H.W., C.W., GAS", for hot water, cold water, and gas respectively. The numbers for each service shall be consecutive. Where valves are located above ACT ceilings, furnish and install valve finder ceiling tack, tack shall be minimum 7/8 in. diameter with 1/2 in. steel point, color as determined by Owner.

B. All valves on tanks and pumps shall be numbered by 3 in. red metal discs with white numbers 2 in. high, secured to stem of valves by means of small solid link brass chain, to correspond to numbers indicated for valves on the Record Drawings and on two (2) printed detailed lists. These printed lists shall state the numbers and locations of each valve and the fixture or group of fixtures which it controls, and other necessary information such as requiring the opening or closing of another valve or valves when any one valve is to be opened and closed, and shall be prepared in form to meet approval of the Architect, and shall be framed under glass.

C. Nameplates, catalog numbers, and rating identifications shall be securely attached to Electrical and Mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

1.14 PIPE MARKER IDENTIFICATION SYSTEM

A. Mark all piping installed under this Section and at all Access Panels with a marking system in basic colors conforming to those specified in ANSI/ASME A-13.1. Markings shall indicate pipe content and direction of flow. Markers shall be applied at all valves and tee joints, and on straight runs of pipe at every 20 ft.-0 in. on center.

B. Markers shall be vinyl snap-around pipe type system. Adhesive markings are not acceptable.

C. Clearly mark potable and non-potable water system with 4 inch wide colored bands, with arrow for direction of flow, every twenty-five (25) feet on center on all piping installed whether it is concealed or exposed and also on both sides of floor and/or wall penetrations. Mark potable water green and non-potable yellow. Within 6 in. of each band identify with letter "Potable C.W.", Non-Potable H.W." Color of letter shall match banding.

1.15 SANITARY, WASTE, VENT, GARAGE WASTE AND VENT, AND STORM SYSTEMS

A. Furnish and install complete Sanitary, Waste, Vent, Garage Waste and Vent, and Storm Drainage Systems (all hereinafter called Drainage Systems) to convey wastes from all Soil and Waste Stacks, Fixtures, Equipment and Roof Drains as indicated and/or described in these Plans and Specifications. Waste piping smaller than 3 in. shall not be used underground. The use of double "Y's" in the horizontal shall not be permitted. All piping shall be installed straight and true and located concealed within building construction.

B. All horizontal Drainage Systems Piping within the building, 3 in. and smaller, shall be pitched at least 1/4 in. per ft. in the direction of flow. Drainage Piping 4 in. and larger shall be pitched at least 1/8 in. per ft. Make changes in direction of drainage lines with 45 wyes, long turn wyes, or sweep bends.

C. Furnish and install all cleanouts indicated on the Drawings and/or where required in Drainage Pipes regardless of size so that the distance between cleanouts does not exceed 45 ft. o.c. Cleanouts shall be installed at the base of all risers and at each change of direction.

D. Refer to drawings for termination points, which generally are connection to existing piping.

E. The Garage Drainage System shall be a complete separate system piped from the holding tank through the roof without interconnection to any other building Drainage System including sanitary waste and vent.

1.16 DOMESTIC WATER SYSTEMS (POTABLE & NON-POTABLE)

A. Furnish, install, sterilize, and test in accordance with the documents and the Plumbing Code, complete potable and non-potable Domestic Cold, Hot, and Hot Water Recirculating Systems including all piping, valves, low point drains, shock absorbers, hangers, insulation, backflow preventers and water heating equipment. Clearly mark the systems as provided above. This work shall start as indicated on the Drawings.

B. In general, piping shall pitch upward in the direction of flow with each branch and riser separately valved and with 1/2 in. hose end drain on the outlet side of the valve and at all low points in the system. Install shutoff valves for each battery of fixtures and other valves as necessary to isolate any part of each system.

C. Install shock absorbers on hot and cold water piping to each fixture. Provide shock absorbers at all quick closing valves and as shown on the Drawings and/or specified.

D. Install a 1/2 inch hose bibb in each toilet room provided with a floor drain. The hose bibb shall be installed under a lavatory.

E. Install a 1/2 inch hose bibb in each mechanical room.

F. Furnish and install a ball valve, balancing valve and check valve at each hot water recirculation line before it connects to another hot water recirculation line.

1.17 COMPRESSED AIR SYSTEM

A. Furnish and install a complete compressed air system as shown on the drawings and herein specified including all valves, piping, fittings, outlets and any incidentals to make a complete and operable system.

B. This work includes furnishing and installing the shop air compressor as herein specified, provision of air outlets as detailed on drawings.

C. Piping shall be run straight and true and shall be rigidly supported from the building construction. All turns and offsets shall be made with fittings as specified elsewhere. Bending of pipe shall not be permitted in this installation.

1.18 FUEL GAS SYSTEM

A. Furnish and install a complete Natural Gas Supply System including pipe, fittings, valves, connections to all gas fired equipment requiring gas, and all accessories and incidentals as indicated or specified. Installation shall be made in accordance with the State Gas Code requirements. Piping shall be installed with an 8 in. long sediment leg at the base of all risers. All changes in direction shall be made with plugged tees for cleaning piping out.

B. All horizontal Gas Piping shall be pitched not less than 1/4 in. in 15 ft. to prevent traps. Pitch piping to risers. Install an 8 in. long sediment leg at the base of all risers. All changes in direction shall be made with plugged tees for cleaning piping out. All horizontal branch outlet pipes shall be taken from the top or side of horizontal mains and not from the bottom. Install shutoff valves for each battery of equipment and other valves as necessary to isolate any part of each system.

C. Where interior gas vented appliances are provided provide a battery powered, carbon monoxide detector adjacent to the appliance.

D. Arrange with the Local Gas Company for the installation of the gas meters, services, and gas pressure regulators. Refer to DIVISION 01 - GENERAL REQUIREMENTS for information regarding Utility Company Charges.

E. Provide seismic restraints for all gas piping per requirements of the Mass. Building Code. Refer also to Section 230548.

F. Plumbing Sub-Contractor shall furnish and install all gas vents for all knockdown regulators whether furnished by this Section, HVAC, or any other Section.

1.19 EQUIPMENT FURNISHED BY OTHERS

A. Miscellaneous items, including but not necessarily limited to the following, shall be furnished and set by others as specified in other SECTIONS of the Documents.

1. Dishwashers
2. Kitchen Equipment

B. Verify the extent of the connection requirements from the General, Architectural, and Mechanical Plans and Specifications.

C. The Plumbing Subcontractor shall be responsible in making final connections to all equipment furnished by others, to ascertain complete cross-connection prevention compliance, and to furnish and install vacuum breaker and backflow preventers which may be required to be Code compliant and are not so furnished with the equipment.

D. All sinks are intended to be "Accessible" and all drain outlets on all sinks and lavatories where furnished by the Plumbing Subcontractor or the other SECTIONS shall have an off-set drain. Set all roughing tight to wall in all cases to comply with ADA Standards. Provide where required ADA insulation kits to prevent injury where a barrier is not included in the casework. Refer to Equipment Drawings.

1.20 DEMOLITION

A. When and as directed by the General Contractor perform all demolition work.

B. All hangers, valves, piping, pumps, fixtures, controllers, and other miscellaneous equipment and materials in the existing building not specifically designated for reuse in the documents shall remain the property of the Owner.

C. Remove as indicated existing Plumbing piping, fixtures, and equipment including all hangers and supports and disconnect all Plumbing connections to equipment to be removed under other Sections of the Specifications. Clean, recondition, and relocate where indicated all items to be reused.

1. Carefully remove shower and toilet room fixtures and trim and deliver in good condition to an on-site location designated by the Architect. The Owner will review all the fixtures and trim and select the items to be kept and the items to be disposed. The disposal of all items not wanted by Owner is specified by the Demolition Section.
2. In cases where main piping is to remain, remove all existing piping to fixtures being removed and cap said piping back to riser or main. All caps or plugs to be installed shall be of like material as pipe being capped or plugged.

3. All piping, valves, hangers, and fittings shall be removed from ceiling and walls as indicated and placed on the floor by this Section. The General Contractor shall remove from the floor and dispose.
4. Any disputes between this Subcontractor and other Contractors or Subcontractors relative to the responsibility for removal of equipment shall be referred to the Architect for decision. The Architect's decision shall be firm and binding and to whomever he designates responsibility for removal of equipment shall do so without any additional cost to the Owner.

D. Make safe the existing fire station building when so directed by the General Contractor. Be responsible to coordinate with utilities and to cap or plug gas, water, storm and sanitary at 10 feet outside building. Notify the General Contractor in writing that all systems are plugged and are safe for demolition.

1.21 PAINTING

A. All interior exposed piping is to be painted and all painting, except as noted, will be done by the Painting Subcontractor. All uncovered piping and hangers shall be thoroughly cleaned of rust, oil, and other containments by the Plumbing Subcontractor and left ready to receive primer coat.

B. Painting for pipe markings shall be done under this Section.

C. Painting of exterior gas piping at gas meter, shall be done under this Section.

1.22 HOISTING EQUIPMENT AND MACHINERY

A. Unless otherwise specified, all hoisting and rigging equipment and machinery required for the proper and expeditious prosecution and progress of the Work of this Section shall be furnished, installed, operated and maintained in safe condition by each sub-contractor, as specified under Section 015000, TEMPORARY FACILITIES AND CONTROLS.

1.23 STAGING AND SCAFFOLDING

A. Unless otherwise specified, each sub-contractor shall provide all lifts and man-lifts, and furnish, erect and maintain in safe condition, all staging and scaffolding as specified under Section 015000 Temporary Facilities and Controls, as needed for proper execution of the work of this Section. Staging and scaffolding shall be of adequate design, erected and removed by experienced stage builders having all accident prevention devices required by Federal, state and local laws.

1.24 BREAKDOWN

A. Submit a breakdown of the contract price to aid the Architect in determining the value of the work installed as the job progresses.

B. No requisition will be approved until the breakdown is delivered to the Architect.

1.25 VISIT TO SITE

A. Prior to submitting a Bid, visit the site of work and become familiar with existing conditions. Any assumptions made are at this Subcontractor's expense.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished under this SECTION shall be new, unused, first quality of a manufacturer of established reputation. Each valve, fitting, section of pipe, and piece of equipment supplied to project shall have cast or indelibly stamped thereon the manufacturer's name, pressure rating where applicable, type, and any other specific information provided by manufacturer. Materials shall conform to Massachusetts Code as a minimum requirement and shall appear on the Massachusetts Approved Plumbing Products list.

2.2 PIPE AND FITTINGS

A. Pipe and fittings shall conform to the latest A.S.A., A.S.T.M., C.A., and F.S. standards.

B. All piping installed under this SECTION shall be in accordance with the following:

Service	Material
Underground Drainage and Vent piping	Service weight cast iron soil pipe-coated bearing collective trademark of the Cast Iron Soil Pipe Institute (CISPI)
Above ground Drainage and Vent, piping 2 in. and larger	No Hub cast iron soil pipe and fittings bearing collective trademark of the CISPI
Above ground drainage, and Vent piping 2 in. and smaller	Type ‘L’ hard tempered copper tubing
Trap primer piping from Primer to floor drain	Type ‘K’ soft rolled copper tubing with Swaged ends
Domestic water piping above ground (potable & non-potable) and Pump Force Main Piping	Type ‘L’ hard tempered copper tubing
Indirect waste piping	Type ‘L’ hard tempered copper tubing coated with two (2) coats of white epoxy paint
Compressed Air Piping	High density polyethylene piping and socket fittings, PE100, ASTM D-3350, chemical resistant, pressure rating of 230 PSI, Air-Pro Piping by Asahi/America or equal.
Gas piping above ground	ASTM A-53 Schedule 40 black steel pipe
Gas piping exposed in kitchen and at cooking island	ASTM A-53 Schedule 40 steel but painted with two (2) coats of white epoxy paint

C. Fittings for underground Drainage Piping shall be service weight bell and spigot pattern C.I. soil pipe fittings. Above ground shall be no hub C.I. soil pipe fittings, Massachusetts Standard.

D. Fittings for sweat drainage piping and force main piping shall be cast bronze or wrought copper of recessed drainage pattern.

E. Fittings for Type 'L' hard tempered copper tubing for potable and non-potable water piping 2-1/2 inch in size and smaller shall be copper press fittings.

1. Acceptable Manufacturers:

a. Viega North America,
b. Elkhart Products Corporation
c. Victaulic
d. Or equal

2. Material:

a. ASTM B88 and ANSI/ASME B16.22. O-rings for copper press fittings shall be EPDM.

3. Installation of copper press fittings and installation are to be made in strict accordance with the manufacturers installation instructions. All tubing is to be reamed prior to the installation of the fitting. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

F. Grooved joint piping systems for domestic water piping 3-inch and larger shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single domestic manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

1. Couplings for Copper Grooved Tube: Victaulic Style 607. Installation ready rigid coupling for direct stab installation without field disassembly.

G. Fittings for polyethylene compressed air shall be injected molded, socket fusion joints with same wall thickness and pressure rating as the pipe, as manufactured by Asahi/America, Inc. or equal.

H. Fittings for gas piping 2-inch and smaller shall be threaded malleable iron gas pattern fittings for screwed pipe. All gas piping 2 ½ inch in size and larger shall be welded and shall utilize butt welded steel pipe fittings.

2.3 JOINTS

A. Joints for underground cast iron bell and spigot soil pipe shall be made up with resilient gaskets. Above ground shall be made up of heavy duty – 4 band stainless steel clamps, and gaskets. Couplings shall be in compliance with CISPI 310 and shall bear the mark of NSF International. Couplings shall be Husky “SD 4000”, Clamp - All HI-TORQ 125, Mission “HW”, or equal.

B. Copper water tubing and fittings shall be assembled with press or grooved fittings depending on pipe size.

C. Grooved Joint Lubricants: Lubricate gasket in accordance with the manufacturer's published instructions with lubricant approved for the gasket elastomer and fluid media.

D. Copper waste and vent tubing and force main tubing with sweat fittings shall be assembled with lead free solder, Silverbrite, Oatey, Harris, or equal, and a non-corrosive flux recommended by the manufacturer.

E. Joints between copper waste/vent tubing and cast iron shall be made with cast iron threaded fittings and copper thread by sweat fittings.

F. Joints between copper tubing and ductile iron water pipe or at flanged joints to tanks shall be made with a combination iron and brass flange with composition gasket and iron bolts.

G. Joints at water heaters or other tanks having threaded connections shall be made up with dielectric unions.

H. Joints between floor or wall flanges and fixtures shall be made with one-piece special molded neoprene gaskets which shall be furnished by the fixture manufacturer.

I. Threaded pipe joints including plastics shall be made up with teflon tape.

J. Joints on screwed gas piping shall be made up with thread compound on male threads only. Welded joints shall be made up by certified welders. All joints on piping 2-1/2 in. and larger, and shall be welded.

2.4 VALVES

A. Furnish and install valves where indicated on the Drawings or where specified and located so that they may be operated, repaired, or replaced with a minimum effort and repacked under pressure.

B. The following list of valves is intended only as a guide for type and quality. Valves shall be as manufactured by Apollo, Milwaukee, Nibco, Elkhart, Watts, Victaulic, or approved equal.

Shutoff valves	Apollo #94VLF-A lead-free ball valves
Balancing valves	ThermOmegaTech Circuit Solver CS, self-acting thermostatic recirculation balance valve.
Grooved end butterfly valves	Victaulic Series 608N for copper
Stop and waste valves 1 in. and smaller	Apollo #95LF-203 through #95LF-205, lead-free
Check valves	Walworth #406 SJ
Gas service stops, 2 in. and smaller	Apollo #70-102-07 through #70-108-07 with tee handle
Gas service stops, 2-1/2 in. and larger	Rockwell #143 lubricated plug valve

Drain valves	Apollo #77WLF-HC ball valve with cap and chain 1/2 in. x 3/4 in. hose end
Compressed air line Shutoff valves	Apollo #70-100 Series-threaded ends
Compressed air outlet valves	Apollo #70-100 Series with automatic drain
Backwater Valve (Drainage Systems) Above ground	Watts BV-200, cast iron backwater with gasketed cover, bronze seat, and no-hub connections.
Backwater Valve (Drainage Systems) Below grade	Watts BV-240, cast iron backwater with gasketed cover, bronze seat, and no-hub connections, and epoxy coated 20-inch x 16-inch x custom height steel access cover. Coordinate custom height of housing enclosure based on invert elevations noted on drawings.

2.5 INSULATION

A. Insulation for all water piping and all horizontal roof leaders whether concealed or exposed shall be 1 in. thick, heavy density, preformed snap-on insulation equal to Johns Manville Micro-Lok HP, 850 degrees snap-on system. Insulation for cold water piping shall have a factory applied vapor barrier with ends and butts sealed with overlapping 4 in. sealing strips.

B. Valves, fittings, and the underside of roof drain bodies shall be insulated with pre-formed fiberglass fitting insulation cut from dense fiberglass blanket and covered with pre-molded P.V.C. fitting covers. P.V.C. covers shall overlap the adjoining insulation and shall be secured with pressure sensitive vinyl tape over a vapor barrier adhesive seal at the joints. (Note: Staples or tacks are not permitted on covers).

C. All insulation shall have self-sealing type, all service jacket (ASJ-SSL) factory applied. At all exposed piping, cover jacket with continuous P.V.C. jacket.

D. Sealers, solvents, tapes, and adhesives, and mastics used in conjunction with the installation of insulation under this Section shall possess the maximum possible fire safe qualities available and shall be NFPA approved.

E. Covering shall be applied over clean and dry surfaces. No covering shall be applied until after the approval of all pressure and leakage tests.

F. Insulation shall be as manufactured by Johns Manville, Inc., Owens-Corning Fiberglass Corporation SSL II-ASJ, or Knauf Insulation 1000. Insulation shall be applied by skilled insulation mechanics in a first class manner.

2.6 TRAPS

A. Furnish and install traps with cleanouts on all fixtures and equipment requiring connection to the sanitary system of the same size and material as the pipe on which they occur. Traps installed on threaded pipe shall be recessed drainage pattern.

2.7 DRAIN VALVES

A. It shall be possible to drain the water from all sections of the Potable and Non-Potable Hot and Cold Water Piping. Furnish and install 1/2 in. x 3/4 in. hose end ball valves with cap and chain. (see 2.04 for model no.)

2.8 SHOCK ABSORBERS

A. Furnish and install, where shown on Drawings and where required to prevent water hammer, Zurn Manufacturing Company model 1260-XL lead free shock absorbers, or equal, as manufactured by J.R. Smith Manufacturing Company, Watts Manufacturing Company, or equal.

B. Installation of absorbers shall be as per manufacturer's recommendations.

2.9 PIPING ACCESSORIES

A. Pressure and Temperature Relief Valves shall be A.S.M.E. rated temperature relief 210 deg. F. double BTU rated, self-closing, as manufactured by Watts Regulator Company or equal by Wilkins, McDonnell and Miller, or equal.

B. Vacuum reliefs shall be lead free Watts Regulator Company #LFN36 or equal by Wilkins or Lawler.

C. Temperature gauges shall be 4-1/2 in. diameter dial thermometers, any angle, and range of 30 degrees F. to 240 degrees F. as manufactured by Weiss Instruments, U.S. Gauge, Trerice or equal.

D. Potable and non-potable Water system pressure gauges shall be 4-1/2 in. diameter with a range of 0 to 160 psi as manufactured by Weiss Instruments, U.S. Gauge, Trerice or equal.

E. Natural gas system pressure gauges shall be 4 inch diameter with a range of 0 to 30 inches of water as manufactured by Weiss Instruments, U.S. Gauge, Trerice or equal.

F. Furnish and install where piping crosses building expansion joints on the domestic water piping and gas piping, expansion joints and anchors sized for 1-1/2 in. expansion per one hundred feet. Expansion joints shall be Metraflex "Metraloop", or manufactured by Flexonic Company or Hyspan, or equal. Piping shall be anchored and guided to force the expansion in the proper direction. Domestic water expansion joints shall be NSF approved. Gas expansion joints shall be AGA approved.

G. Trap primer connections are required on all floor drains to maintain trap seal. The requirement for trap primer connections shall include all floor drains in the kitchen including trough drains furnished by others. Trap primers shall be Precision Plumbing Products, Inc., Model PRO1-500 flow activated prime-pro trap-primer valve or shall, where appropriate, be Zurn, Watts, Smith or equal in-line connections installed on flush valve supply. Electronic trap primer shall be Precision Plumbing Products, Inc. Model MPB-500 mini-prime electronic trap-primer manifold, 120 volt, single phase. Furnish distribution units as required. Provide PPP AG-500 air gap fitting at all locations.

2.10 HYDRANTS AND HOSE BIBB

A. Wall hydrants shall be Zurn Series Z-1310-PB Ecolotrol cast brass 3/4 in. non-freeze wall hydrant with integral backflow preventer, 3/4 in. hose connections, polished nickel bronze face, loose key handle, brass wall sleeve, and fitted with brass locknut.

B. Roof hydrants shall be Zurn Series Z-1388-RK exposed non-freeze roof hydrant with dura-coated cast iron head and lift handle with lock option, bronze interior parts, galvanized steel casing, and bronze valve housing with drain port. Complete with dura-coated cast iron roof support sleeve with anchoring flange and clamp collar. Contractor shall run drain to exterior. Coordinate drain location with Architect.

C. Hose bibb shall be T & S Brass or equal model #B-720 modified, chrome plated, 3/4 in. hose end, integral stop, vacuum breaker, modified with lock shield and loose tee handle.

D. Hydrants shall be manufactured by Zurn, J.R. Smith, Watts, or equal. Hose bibbs shall be manufactured by T&S Brass, Speakman, Chicago, or equal.

2.11 CLEANOUTS

A. Cleanout plugs on the Sanitary System shall be of heavy cast brass of the screwed type. Plugs shall be full size up to and including 4 inch.

B. For piping running under floor slab, cleanouts shall be brought up to just under the floor slab level. Furnish and install access cover for all floor-type cleanouts, Zurn ZN-1400 Series with scoriated nickel bronze or by Watts, J.R. Smith, or equal. In the garage area and at exterior locations use Zurn model #Z-1474 cleanout housing set over brass cleanout plug.

2.12 ACCESS DOORS

A. Furnish Access Doors for access to all concealed control valves, cleanouts, valves, expansion joints, and to all other concealed parts of the Plumbing System that require accessibility for the proper operation and maintenance of the system. These doors shall be installed under the appropriate SECTION of the Specifications as determined by the surface upon which the panels are mounted.

B. All Access Doors shall be located in a workmanlike manner in closets, storage rooms, and/or other non-public areas, positioned so that the valve or part can be easily reached, and the size shall be sufficient for this purpose (minimum size 12 in. x 16 in.). Furnish Access Doors for each pipe space to permit thorough inspection of same. When access doors are required in corridors, lobbies, or other habitable areas, they shall be located as directed by the Architect.

C. Refer to Section 083100 - Access Doors and Frames, for all product requirements for furnishing access panels.

D. Coordinate locations and schedule with the work of trades involved with construction in which access panels will be installed.

E. Access Door Shop Drawings shall be submitted to the Architect for approval.

F. All access panels shall be keyed alike. Coordinate keying with other trades.

2.13 SUPPLEMENTARY STEEL, CHANNEL, AND SUPPORTS

A. Furnish and install all supplementary steel, channels, and supports required for the proper installation, mounting, and support of all equipment.

B. Supplementary Steel and Channels shall be firmly connected to building construction in a manner approved by the Architect.

C. The type and size of the Supporting Channels and Supplementary Steel shall be determined by the Plumbing Subcontractor and shall be sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

D. All Supplementary Steel and Channel shall be installed in a neat and workmanlike manner parallel to the walls, floor, and ceiling construction. All turns shall be made with 90 deg. fittings, as necessary to suit the construction and installation conditions.

2.14 HANGERS, ANCHORS, GUIDES, AND PIERS

A. All piping shall be supported from the Building Structure by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitching of lines, to prevent vibration, and to secure piping in place, and shall be so arranged as to provide for expansion and contraction.

B. Hangers shall not be installed directly into the roof deck. Provide supplementary steel per paragraph 2.13 above as required to support piping from structure.

C. The spacing for hangers for horizontal piping shall be in accordance with the following:

1. Cast Iron Soil Pipe: 5 ft.-0 in. at the hubs for 5 ft. lengths. For 10 ft. lengths, use one (1) hanger at the hub and one (1) at midpoint of the length. Install cast iron pipe in accordance with CISPI Handbook - latest edition.
2. Copper Tubing: 6 ft.-0 in. o.c. for 1-1/4 in. and smaller, and 10 ft.-0 in. o.c. for 1-1/2 in. and larger.
3. Steel Pipe: 10 ft.-0 in. o.c. for 1-1/2 in. and over; 8 ft. - 0 in. for 1-1/4 in.; 6 ft. – 0 in. for 1 in. and smaller.

D. Hanger rod diameter shall be as follows:

Pipe Size	Rod Diameter
1/2 in. thru 2 in.	3/8 in.
2-1/2 in. and 3 in.	1/2 in.
4 in. and 5 in.	5/8 in.
6 in.	3/4 in.
8 in. and over	7/8 in.

E. Vertical lines shall be adequately supported at their bases by a suitable hanger placed in the horizontal line near the riser and at every 10 ft. interval.

F. All Hangers shall be adjustable Clevis Hanger. Hanger rods shall have machine threads. Malleable iron brackets of approved type shall be used along the walls. All Hangers for copper tubing shall be copper plated except where pipe is insulated, in which case, Steel Clevis Hanger and pipe shield shall be used.

G. Piping shall not be hung from the hangers of other trades.

H. Provide seismic restraints for all piping per requirements of the MA Building Code and Section 230548. All gas piping shall be seismically restrained.

I. Hangers shall be manufactured by Grinnell, Carpenter and Paterson, Fee and Mason, or equal.

J. Wire and strap hangers will not be permitted in this installation.

K. Install a 14 gauge metal pipe shield between pipe insulation and all pipe hangers. Hangers shall be sized so that the pipe insulation passes through the hanger and is supported on the shield.

2.15 DRAINS

A. Furnish and install all floor drains and roof drains where shown on the Drawings.

B. All floor drains in flooring systems without waterproofing membranes shall have galvanized iron clamping rings with 6-pound lead flashing to bond 9 in. in all directions. All drains shall be checked with Architect's Drawings to determine depth of the flashing collar. Brass extension pieces shall be provided if necessary.

C. All floor drains installed on this project shall be fitted with Automatic Trap Primer Connections. Field determine appropriate location for Trap Primer valve and drain piping.

D. Drain Schedule:

1. Type "A" – (General) Zurn #ZN-415-5BZ-P dura coated cast iron body with bottom outlet, combination invertible membrane clamp, adjustable collar, seepage slots, type BZ polished nickel bronze, light-duty, leveling strainer, trap primer connection.
2. Type "B" (Mechanical Room) - Zurn #Z-550-Y-P, 9 in. diameter top, dura coated cast iron body bottom outlet,seepage pan, combination membrane flashing clamp, frame for medium-duty, cast iron, heel-proof slotted grate, sediment bucket, cast iron grate, trap primer connection
3. Type "C" (Garage) - Zurn #Z-512-G-Y-VP Galvanized heavy duty cast iron body sediment bucket, heavy duty ductile iron secured grate, caulk bottom outlet.
4. Type “D” – not used
5. Type "E" (Gear Extractor) - Zurn #Z-1995-LD-P-4, 24 inch x 16 inch x 17 inch, white acid resistant coated interior and exterior, steel body with integral anchor flange, less bottom dome, full grate with square center opening, and ½ inch trap primer connection.

E. Drains shall be of one manufacturer, by Zurn, J.R. Smith, Watts, or equal.

F. In bathrooms, Kitchen, and Mechanical Rooms, coordinate all floor drain locations in field with Architect. Floor drains shall be set at an elevation/grade to allow for floor drainage from all directions. Drain locations shall not conflict with toilet partition walls.

2.16 PLUMBING FIXTURES

A. Furnish and install all fixtures and equipment, including supports, connections, fittings, and any incidentals, to make a complete installation in accordance with the Drawings and as specified.

B. The Architect shall be final judge as to whether fixtures and trim fulfill the requirements of the Specifications and as to whether they are of suitable quality.

C. All fixtures requiring hot and cold water shall have the cold water faucet on the right hand side of the fixture and the hot water faucet on the left hand side of the fixture.

D. Escutcheons shall be furnished and installed on all supplies and traps. Escutcheons shall be one (1) piece chrome plated brass with set screws.

E. All fixtures shall have the manufacturer's guaranteed label or trademark indicating first quality. All acid resisting enameled ware shall bear the manufacturer's symbol signifying acid resisting material.

F. Unless otherwise specified, faucets and all exposed fittings shall be chromium plated.

G. All supply pipes shall run in a reasonable straight vertical line from the stops to faucets. Traps shall be installed perpendicular to walls.

H. Vitreous china and acid resisting enameled fixtures shall be of one manufacturer by Sloan, American Standard, Toto, or equal. Trim shall be Symmons, Speakman, Chicago, T & S Brass, or equal. Flush valves shall be Sloan, Toto, Zurn, or equal. Water coolers and drinking fountains shall be manufactured by Elkay, Just, Filtrine, or equal. Stainless steel sinks shall be Elkay, Just, Kindred, or equal.

I. Note: All fixtures and fittings shall be vandal proof mounted, unless specifically noted otherwise.

J. Carefully coordinate roughing for flush valves so that the dimension from top of fixture to C-L of flush valve is a minimum of 6 in..

K. Fixture Schedule:

1. P-1 Water Closet:

Sloan Model WETS-2450.1001-1.28 complete toilet system with exposed manual Royal flush valve, top spud, 1.28-gallon flush, and wall hung, elongated, vitreous china fixture.

Olsonite #95-C Lustra solid plastic white open front seat with check hinge.

Zurn 300-pound carrier as required to suit. Carefully coordinate with Architect’s plans to fit wall. Use Z-1209 where dictated by conditions.
The mounting height shall conform to Accessibility Standards. Locate handle of flush valve to wide side of toilet stall. Refer to Architect's Drawings for the exact location of fixture and mounting height and re-verify during construction with the Field Architect.

2. P-2 Wall Hung Lavatory, Accessible (Public):

Kohler K-2054 "Soho", wall mounted, 20 in. x 18 in., white vitreous china lavatory, 4-inch centers, punched for concealed arm chair carrier.

Chicago EQ-A12C-23ABCP, 4-inch centers, self-generating with battery backup sensor faucet with 0.35 GPM laminar flow outlet and integral thermostatic mixing valve with checks on each supply.

McGuire Model 155 WC offset drain with open grid strainer.

McGuire H167 LK (pair) C.P., 3/8 IPS angle supply with loose key stop.

McGuire B-8902 C.P., 1-1/4 in. x 1-1/2 in. cast brass adjustable 'P' trap with cleanout and 17 GA tubing outlet to wall.

Zurn #ZR-1231 floor mounted concealed armchair carrier.

Provide roughing insulation kit on waste outlet, p-trap, and water supplies.

3. P-2A Wall Hung Lavatory, Accessible (Staff):

Kohler K-2054 "Soho", wall mounted, 20 in. x 18 in., white vitreous china lavatory, 4-inch centers, punched for concealed arm chair carrier.

Chicago 420-E2805ABCP deck mounted, 4-inch centers, single lever handle, 0.5 GPM non-aerating outlet, Powers LFG480 tempering valve.

McGuire Model 155 WC offset drain with open grid strainer;

McGuire H167 LK (pair) C.P., 3/8 IPS angle supply with loose key stop.

McGuire B-8902 C.P., 1-1/4 in. x 1-1/2 in. cast brass adjustable 'P' trap with cleanout and 17 GA tubing outlet to wall.

Zurn #ZR-1231 floor mounted concealed arm chair carrier.

Provide roughing insulation kit on waste outlet, p-trap, and water supplies.

4. P-3 Under Counter Mounted Lavatory, Accessible (Staff):

American Standard “Ovalyn” Model 9482.000, vitreous china, 16-3/4”x13-1/4”x4” deep, under counter sink with rear overflow.

Chicago 420-POMP-ABCP deck mounted, 4-inch centers, single lever handle, 1.5 GPM outlet, pop-up drain Powers LFG480 tempering valve.

McGuire Model 155 WC offset drain with open grid strainer;

McGuire H167 LK (pair) C.P., 3/8 IPS angle supply with loose key stop.

McGuire B-8902 C.P., 1-1/4 in. x 1-1/2 in. cast brass adjustable 'P' trap with cleanout and 17 GA tubing outlet to wall.

The casework includes roughing protection knee guard. Rough tight to wall.

5. P-4 Shower, Accessible:

Symmons 1-25-FSB-E-VB Safetymix Pressure Balancing Mixing valve with lever handle, factory pre-set temperature limit stops, FS hand spray unit with 2.5 GPM flow restrictor, in-line vacuum breaker, 60 in. flexible hose, 30 in. wall mounted slide bracket rod with heavy duty (250 lb) anchors.

Aquatic 1363BFSCMA acrylic surround unit, 36-inch x 36-inch roll-in type shower – ADA Compliant receptor,1/2-inch threshold, grab bars and fold up seat.

6. P-5 Sink, Under counter mount, Accessible:

Kohler K-3822-3 single bowl, 25 in. x 22 in., under countertop mounted 9 5/16 in. deep, 18 ga. type 304 stainless steel sink with rear outlet; three (3) hole punched faucet ledge.

Provide Moen “M-Dura” model 8227 - 1.5GPM, 8-inch widespread, dual lever faucet with gooseneck spout.

Just J-ADA-35 crumb cup strainer with 1-1/2 in. offset tailpiece and stainless steel ground

seat stopper.

1-1/2 in. x 2 in. chrome plated P-trap with cleanout, waste outlet with escutcheon.

Pair of 1/2 in. x 3/8 in. supplies with stops and escutcheons.

The casework includes roughing protection knee guard. Rough tight to wall.

7. P-6 Sink, Under counter mount, Accessible:

Elkay ELUH1814PD single bowl, 18 in. x 14 in., under countertop mounted 7-7/8 in. deep, 18 ga. type 304 stainless steel sink with rear outlet.

Provide Moen “Align” model 5923 - 1.5GPM, single post, single lever faucet, gooseneck spout with pull down spray.

Just J-35-316 crumb cup strainer with 1-1/2" tailpiece and type 316 stainless steel ground seat stopper.

1-1/2" x 2" chrome plated P-trap with cleanout, waste outlet with escutcheon.

Pair of 1/2" x 3/8" supplies with stops and escutcheons.

8. P-7 Wall Hung Bottle Filler, Accessible:

Elkay LZWSSM, bottle filler, stainless steel finish, wall mounted, ADA compliant, and sensor-activated bottle filler.

1-1/4 in. x 1-1/2 in. rough p-trap with cleanout; 1/2 in. ball valve stop.

9. P-8 Sink:

Elkay ELUH-281612, under mount, single bowl sink, 11-1/2" deep, 18 ga. type 304 stainless steel sink with rear center outlet.

Advance Tabco pre-rinse faucet, model K-115, splash deck mounted faucet, single hole, spring action flexible swing gooseneck, 2-3/8 inch blade handles, K-114 hand spray.

Elkay LKAD-35-304 crumb cup strainer with 1-1/2 in. offset tailpiece and stainless steel ground seat stopper.
1-1/2 in. x 2 in. chrome plated P-trap with cleanout, waste outlet with escutcheon.

Pair of 1/2 in. x 3/8 in. supplies with stops and escutcheons.

10. P-9 Mop Receptor (24x24):

Stern-Williams MTB-2424-BP, 24 in. x 24 in. x 10 in. molded stone mop service basin with stainless steel rim guard on exposed sides, 3 in. caulk connection, stainless steel strainer, splash guard. Plumbing Subcontractor to include caulking and sealant to seal between unit, finished wall and floor.

T&S Brass model B-0665-BSTP service sink fitting, polished chrome, brace to wall, integral screwdriver stops, vacuum breaker, 3/4 in. hose end, 2 in. lever handles, provide 1/2 in. check valve on each supply to fitting with access panel.

Furnish and install 1/2" hot and cold reduced pressure backflow preventer capped for future soap dispenser.

11. P-10 Clothes Washer:

Symmons No. W-602-X Laundry-Mate Supply and Drain Fixture, recessed mounting box 1/2 in. hot and cold-water connections, 2 in. waste connection, integral stops and check valves on supplies.

12. P-11 Emergency Eye Wash, Recessed:

Guardian model GBF-1735DP, recessed barrier free omni-flow Emergency Eye/Face Wash including stainless steel drain pan. Recess barrier free eye/face spray head with stainless steel panic bar and stay open C.P. brass ball valve. Provide waste to discharge to floor.

Provide Guardian Model G6020-XXX thermostatic mixing valve with recessed stainless-steel cabinet, 13 gallons at 30 psi.

13. P-12 Water Hose Reel:

Hannay Reels, Inc. Model 818-25-26B-SR hose reel with 70-foot ¾" hose.

14. P-13 Air Hose Reel:

Hannay Reels, Inc. Model N716-23-24-15.5G hose reel with folding bracket mount, 75-foot ¾" hose.

2.17 BACKFLOW PREVENTERS

A. Backflow preventers shall be reduced pressure type furnished complete with shutoff valves, Massachusetts Approved. Backflow preventers 2-1/2 inch and smaller shall be Watts #LF009-QT-S. Backflow preventers 3 inch and larger shall be Watts 957-QT. Backflow preventers shall be lead free, all bronze, complete with strainer and soft seated check valve. Size shall be as indicated on Drawings.

B. Mount backflow preventer 3 ft.(+/-) above finished floor. Provide indirect waste funnel and run pipe to an air gapped discharge at sink or floor drain. Furnish a spare parts kit and parts list mounted in the vicinity of the device.

C. Prior to the installation of devices in the name of the Owner file for, pay for, and obtain all required permits and approvals for cross connection control devices from the Authority having Jurisdiction.

D. Backflow preventers shall be of one manufacturer, by Watts, Wilkins, Beeco, or equal.

2.18 UNION AND NIPPLES

A. All connections between copper tubing and galvanized piping or between copper tubing and all tanks (such as water heaters, chillers, and similar equipment) shall be made with dielectric unions and nipples.

B. All connection to Water Heaters, Meters, Pumps, and other equipment requiring maintenance or alteration shall be made up with unions. Unions on brass piping, 2 in. and smaller, shall be brass composition "E" in strict accordance with Federal Specification WW-U-516. On plastic piping, use unions of the same material as the piping.

C. All close and shoulder nipples shall be corresponding materials as the pipe and shall be extra heavy.

2.19 ELECTRIC WATER HEATERS (EWH-1 and 2)

A. Water heaters shall be as manufactured by Rheem, Hubbel, RUUD, or equal.

B. Provide two packaged type electric water heaters, (2) two Model No. E175A as manufactured by Rheem Water Heating, Roswell, GA.

C. The pressure vessel sections, including the electrical control panels, shall be mounted on structural supports and be suitably insulated, jacketed, painted, and provided with lifting lugs. The entire unit is to be packaged ready for plumbing and electrical service connections and shall bear the UL listing mark certifying the entire water heater.

D. The pressure vessels shall be all welded construction and ASME Code Section IV stamped for a working pressure of 125 psi and contain a minimum of 350 gallons of storage. The storage vessel shall be carbon steel and lined with seamless Hydrastone Cement to a minimum thickness of 5/8" on 100% of all interior tank surfaces. The pressure vessel is to be completely covered with 2" thick "E" type energy conservation fiberglass blanket insulation and enclosed in a heavy gauge galvanized steel metal jacket finished in gray hammertone enamel. An ASME approved automatic reseating combination temperature and pressure relief valve set at the tank WP and 210°F shall protect the vessel.

E. The recovery sections shall be rated at 18 kW which will heat 74 GPH of water at 100 deg. F rise.

F. The heater shall be designed to operate at 208 volts, 3 phase, 60 Hz, with a fused low voltage transformer providing 120 volt to all operating controls. The immersion heating elements shall be high quality copper sheathed and sized to obtain the rated recovery. Each element circuit is to be independently operated through a definite purpose magnetic contactor having a resistive load rating equal to or exceeding the ampere rating of that particular circuit and shall be protected by individual power fuses rated at approximately 125% of the ampacity of the circuit. Multiple circuit elements shall be provided with a master terminal block for connecting of the incoming power feeds. A safety door interlock switch shall interrupt power to the control circuit when the control panel door is opened. The control thermostat shall be immersion type and shall be consistent with the recovery rate of the heating element as to the number of steps required. A hi-limit control with a manual reset button shall be factory installed to disconnect all ungrounded conductors to the heating element(s) in the event of an over-temperature condition in the storage section.

G. In addition, the water heaters shall be supplied with a digital display electronic temperature controller and with Building Automation System package for remote operation and alarm conditions (IP).

H. The water heater manufacturer shall warranty all electrical components against defects in workmanship and material for a period of one (1) year from date of start-up, and the pressure vessel for a full five (10) years Non Pro-Rated from date of start-up, provided that the unit is started within three (3) months of date of shipment and installed and operated within the scope of the tank design and operating capability.

I. Expansion Tank (ET-1): Furnish and install as shown on plans a 45 gallon (30 gallon acceptance volume), 20 in. diameter x 39 in. (high) pre-charged steel thermal expansion tank with a fixed FDA approved butyl bladder. The tank shall have a top NPT stainless steel system connection and a .301 in. - 32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped 150 psi working pressure. Tank shall be Wessels model number TTA-100 or by Amtrol, Taco, or approved equal.

J. Provide the service of a factory-trained representative on the jobsite to check installation, supervise startup, and instruct the operator. Provide a minimum of 2 hours of training for the site facilities people prior to the system being turned over to the Owner. Training shall include operation of water heater, mixing valve, and recirculation pump.

2.20 TEMPERING VALVE

A. Tempering valves shall be as manufactured by Powers, Acorn Controls, Heat Timer Corp, or equal.
B. Furnish and install where shown for temperature control at all domestic water heating systems, Powers Intellistation Jr., model LFIS100VL, digital mixing valve. In case of power failure valve shall flow full cold for safety. Provide inlet check-stops, outlet volume/shutoff valve, dial thermometer, and test connection. Valves are to be factory assembled and tested.
C. Furnish and install a 4 in. diameter thermometer on the outlet side of each tempering valve as manufactured by U.S. Gauge Company, Powers Regulator Company, and/or Trerice Company.

2.21 RECIRCULATING HOT WATER PUMP

A. Circulators shall be all-bronze booster type, Grundfos Alpha2 15-55SF or equal by Bell & Gossett, Taco or approved equal.
B. Furnish and install, where shown on the Drawings, an immersion aquastat, Honeywell #L-4006-A set to start and stop pump at a 10 degree differential temperature.
C. Circulators shall be connected to the Building Management System by Division 23.

2.22 WATER METER

A. Furnish and install water meter with inlet strainer in accordance with the standards of the Local Water Department. Coordinate the installation with the water department and include in the Plumbing Bid the cost of the meter. Refer to Part 1 of this section regarding assessments, and the like.

2.23 EMERGENCY GAS SOLENOID VALVE

A. Emergency gas solenoid valve shall be normally closed FM approved gas solenoid valve ASCO "Red-Hat" Series 8040/8215. Valve shall operate on 120volt power and shall close the gas flow on the main gas feed to the Kitchen cooking equipment. This solenoid valve is furnished and installed by Section 220000.

B. Gas solenoid valves shall be manufactured by ASCO, QMI, ISIMET, or equal.

2.24 ELEVATOR SUMP PUMPS

A. Furnish and install in each elevator pit a simplex Stancor Traction Minder Elevator System, 2" submersible sewage pump. Pump shall be Stancor WES-50 submersible. Pump shall be rated to provide 50 GPM @ 22' TDH. Pump motors shall be submersible and not less than 0.5 HP, 115Volt, 1phase, 3,450 RPM and 60 HZ.

B. Controls shall include Stancor Series CB1000-1 single phase simplex controller, three float switches mounted to the discharge pipe with 20' cord, NEMA 4X enclosure, High Water Alarm, Test and Silence selector switch, high water alarm horn with silencer, and one set of isolated dry contacts for remote alarm.

C. At each installation furnish and install oil separator as detailed. Oil Separator shall be Striem model #OS-50-SS, made in USA of seamless, rotationally-molded polyethylene. Interceptor shall be furnished for below grade installation. Interceptor flow rate shall be 50 GPM. Interceptor oil capacity shall be 40 gallons. Cover shall provide water/gas-tight seal and have maximum 2,000 lbs. load capacity. Unit shall have a lifetime guaranteed.

D. Provide complete Striem Slick Stick monitoring system including interface float, alarm panel, and all control wiring and conduit from separator to control panel. Monitoring system shall provide warning of high oil level conditions with interface float. Alarm panel shall be NEMA 4X corrosion resistant, weatherproof enclosure. The single phase, 120 volt, 60 hertz power shall be provided to the panel by Division 26. Panel shall include audible alarm buzzer, 95db pulsing horn with no timeout, high oil light, power on light inside enclosure visible from the outside, horn off button that silences the audible alarm, and test button. Panel shall be supplied with extra dry contact for connection to a building management system.

2.25 COMPRESSED AIR REGULATORS

A. At all compressed air connections, furnish and install "Parker-Watts" model C105-04BLWJDWR, 1/2" combination air filter and pressure regulator. Install quick connect at outlet. Manufacturers shall be Parker- Watts, Ingersoll Rand, Control Air or approved equal.

2.26 AIR COMPRESSOR (AC-1)

A. Furnish and install a compressed air system with vertical storage tank, dryer, and all required accessories to provide an automatic supply of shop air to serve station outlets and equipment.

B. Air compressor shall be Quincy Model QGSV-25 air compressor, 120 CFM at 100 PSI, 25-HP, 2080 volt, 3 phase 60 HZ motor, with manual resets, automatic condensate drain, tank mounted pressure gage, service valve and safety valve.

C. Storage tank shall be 200 gallon vertical ASME receiver, with tank mounted pressure gage.

D. Provide Quincy QPNC-125 compressed air dryer, 120 v, single phase, and Quincy QCS 100 oil water separator.

E. Compressor to be supplied with QMF-75 coalescing filter.

F. Run auto-drain discharge to nearest floor drain.

G. Compressor shall be manufactured by Quincy, Ingersoll Rand, Atlas, or equal.

2.27 SPECIAL WASTE HOLDING TANK

A. Furnish and install as shown and as detailed on the Plumbing Drawings, size dimensions and details, a double wall fiberglass reinforced underground storage tank for non-potable water storage as manufactured by Xerxes Corporation or approved equal. Tank shall be lined with vinyl ester resin or factory approved lining. Tank shall be furnished complete with manways and risers to grade, cast iron frames and covers, hold down straps, turnbuckles, precast concrete deadmen, tappings for inlets, tank vents, and for interstitial monitoring and level indicators.

B. Provide buoyancy calculations from manufacturer. Buoyancy calculations shall be calculated with the tank empty, water table at the same elevation as grade, and using factory supplied deadmen. Provide all necessary precast concrete deadman, hold down straps, and turnbuckles to provide a minimum buoyancy safety factor of 1.2:1.

C. Excavation, Backfill, Hold down pads and cast iron frames and cover are specified under Division 31. Be responsible, however, and furnish factory trained personnel from the tank manufacturer to inspect the conditions and materials to meet their requirements. Report any deficiencies to the Architect.

D. Furnish and install under this Division 22 between the tank and the panel all conduit and wiring for the interstitial and tank alarm systems. All such conduit and wiring shall be furnished and installed consistent with materials and methods specified under Division 26.

E. Tank shall be installed and tested in accordance with the Xerxes Installation Manual and Operating Guidelines for Single-Wall and Double-Wall Fiberglass Underground Storage Tanks.

2.28 HOLDING TANK MONITORING SYSTEM (IWT-1)

A. Furnish and install including all conduit and wiring between the panel and the holding tank an Omntec LU2-LF-HL, audio/visual alarm console wall mount NEMA & enclosure complete with Omntec L-1-SS stainless steel hi-level float switch assembly with custom length which will signal tank contents to be pumped. Switch shall be set at level indicated on Drawings. For interstitial monitoring furnish and install Omntec LWF dry interstitial sensor.

B. Panel shall be provided with additional dry contacts to signal “high water alarm signal” or “tank failure” alarm to the Building Management System. The 120-volt power supply to the panel is furnished and installed under Division 26. Wiring from panel to the Building Management System is furnished and installed under Division 23.

2.29 SEWAGE EJECTORS

A. Furnish and install one (1) complete duplex sewage ejector system as shown on the Drawings and herein specified. Include in this Section all materials and equipment including pumps, panels, and the fiberglass basin. Furnish and mount the pump control panel at the location shown on the Drawings. The incoming power sources to the panel, conduit from the panel to the basins, and all required conductors including power and controls between the basins and control panel are furnished under the Electrical Section. The Electrical Subcontractor will connect the pumps. Final connection of all control wiring, sequencing, and start up are to be furnished under Section 220000 and shall be performed by the pump supplier with factory trained technicians.

B. Pump System shall be Weil Pump Company or equal duplex, submersible, sewage ejector system complete with factory wired NEMA-1 duplex, double door, factory pre-wired control panel and Series 8234 mechanical float switch control system. Include stainless steel lifting cables.

C. Pumps shall be Weil Series 2554 submersible type pump for sewage service and each pump shall be rated to pump 30 GPM at 15 ft. TDH. The pump casing shall be one piece cast iron fitted with bronze impellers machined and balanced to provide the above flow characteristics. Each pump shall have Weil series 2613 removal rail system with stainless steel lifting rope.

D. Pump motor shall be vertical, NEMA and not less than 3 HP, three (3) phase, 208 volts, 60 cycle, AC, 1750 RPM and of an air filled, hermetically sealed design. Motor shaft shall be 300 series stainless steel with keyway for positive positioning of impeller. Motor shall be UL explosion proof.

E. Control panel shall include electric alternator, motor starters, fused disconnects, capable of being locked in the "open" position, control circuit disconnect, high water alarm with audio/visual silencer, dry contacts for remote annunciation, moisture sensor, and temperature limiter. Panel shall be located where shown. Wiring is specified in Section 260000.

F. Controls shall be Weil Pump Company Series 8234 mechanical float switches which are to be mounted on galvanized support pole and furnished with sufficient cable on each float to run wiring back to control panel.

G. System shall be furnished complete with a 36" dia. x 4′ - 0" deep, two-piece, fiberglass basin with anti-flotation collar, floor frame, manhole opening, and all required through floor connections. Cover shall be gasketed tight to the floor frame and shall include a separate 11″ x 15″ inspection manhole within the overall cover.

2.30 WATERTIGHT FOUNDATION LINK SEAL

A. Use a mechanical seal, consisting of rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

B. Link-Seal pressure plates shall be molded of glass reinforced nylon. Hardware shall be 316 Stainless Steel, Per ASTM F593-95 Tensile Strength = 85,000 psi, average. Coloration shall be throughout elastomer for positive field inspection.

C. Each link shall have permanent identification of the size and manufacturer’s name molded into the pressure plate and sealing element.

D. The contractor will submit to verify the modular seals are domestically manufactured at a plant with a current ISO-9001:2000 registration.

E. Modular mechanical seals shall be manufactured by EnPro Industries, Trumbull, Eaton, Pipeline Seal & Insulator, or approved equal.

2.31 FIRESTOP SYSTEMS

A. General: Provide firestopping at all new fire-rated construction where penetrated by the Work of this Section.

B. Refer to Section 078410 – Penetration Firestopping, for all product requirements for maintaining integrity of fire-rated construction at penetrations.

2.32 SCAFFOLDS AND STAGING

A. General: Trade Contractors shall obtain required permits for, and provide scaffolds, staging, and other similar raised platforms, required to access their Work as specified in Section 01 50 00 - Temporary Facilities and Controls and herein.

1. Scaffolding and staging required for use by this Trade Contractor pursuant to requirements of Section 01 50 00 - Temporary Facilities and Controls shall be furnished, erected, maintained in a safe condition, and dismantled when no longer required, by this Trade Contract requiring such scaffolding.
2. Each Trade Contractor is responsible to provide, maintain and remove at dismantling, all tarpaulins and similar protective measures necessary to cover scaffolding for inclement weather conditions other than those required to be provided, maintained and removed by the General Contractor pursuant to MGL (Refer to Section 01 50 00 - Temporary Facilities and Controls and as additionally required for dust control).
3. General Contractor is responsible to provide enclosures required for temporary heat; refer to Section 01 50 00 - Temporary Facilities and Controls.

    a. Furnishing portable ladders and mobile platforms of all required heights, which may be necessary to perform the work of this trade, are the responsibility of this Trade Contractor.

2.33 HOISTING MACHINERY AND EQUIPMENT

A. All hoisting equipment, rigging equipment, crane services and lift machinery required for the work by this Trade Contractor shall be furnished, installed, operated and maintained in safe conditions by this Trade Contractor, as referenced under Section 01 50 00 - Temporary Facilities and Controls.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION METHODS

A. All work shall be installed in a first-class manner consistent with the best current practices. All materials shall be securely installed plumb and/or level, and all flush mounted equipment shall have front edge flush with finished wall surface.

B. All piping shall be installed true to line and grade in the case of underground piping. All piping above ceilings or exposed shall be grouped together, be parallel to each other, and be either parallel or perpendicular to the structure. Utilize gang hangers wherever feasible. Group all valves together where feasible.

C. Training:

1. Train the Owner's maintenance personnel on troubleshooting procedures, and servicing and preventative maintenance schedules and procedures.
2. Schedule training with Owner through the Architect with at least 7 days prior notice.

3.2 WORK COORDINATION AND JOB OPERATIONS

A. The equipment shall not be installed in congested and possible problem areas without first coordinating the installation of same.

B. Particular attention shall be directed to the coordination of piping and other equipment installed in the ceiling areas. Coordinate the elevations of all piping in hung ceiling areas to insure adequate space for the installation of recessed lighting fixtures before other mechanical equipment is installed.

C. Furnish to the General Contractor, and all other Subcontractors, all information relative to the portion of the Plumbing installation that will affect them, sufficiently in advance so that they may plan their work and installation accordingly.

D. In case of failure to give proper information as indicated above sufficiently in advance, pay for all back-charges for the modification, renovation, and relocation of any portion of the work already performed.

E. Obtain from the other trades, all information relative to the Plumbing Work to be executed in conjunction with the installation of their respective equipment.

3.3 CUTTING AND CORE DRILLING

A. Perform all cutting and core drilling operations that are outlined in Part 1 of this SECTION. Throughout the performance of the cutting and coring work, ensure that the structural integrity of the walls, floors, overhead structure, and other structural components, which are to remain, is maintained until permanent work is installed. Prior to any coring or cutting, verify all locations of same with the General Contractor. All cutting and coring is to be performed in accordance with approved Coordination Drawings

B. Cut all masonry and concrete with an approved diamond blade concrete saw in a neat straight direction, perpendicular to the plane of the wall or floor.

C. Use a core drilling process which produces clean, sharp edges and the minimum hole size which will accommodate the size of pipe sleeve specified. Submit procedures for cutting thru existing steel beams to Architect for review.

D. The patching of holes shall be performed by Plumbing Sub-contractor utilizing methods outlined for the finish trade involved. Holes shall be patched to the satisfaction of the Architect.

3.4 CLEANING AND PROTECTION

A. Protect all materials and equipment during shipment and so as to prevent damage. Water closets, lavatories, and sinks shall be boarded over and all other fixtures shall be protected with pasted on paper. Post notice prohibiting the use of the fixtures prior to completion. Assume full responsibility for protection of work until its completion and final acceptance.

B. Keep the premises reasonably clean at all times and remove rubbish caused by the Plumbing Work as directed by the Architect.

C. Upon completion of this work, clean all fixtures and equipment installed herein and replace damaged parts. Failure to fulfill this obligation will result in back-charges for correction of the defective work.

3.5 SLEEVES, INSERTS, AND ESCUTCHEONS

A. All piping passing through slabs, floors, walls, partitions, foundation walls and grade beams, shall be sleeved and all such sleeves shall be furnished and installed by the Plumbing Subcontractor as detailed on the Drawings and herein specified. Set sleeves in concrete floors and walls as soon as forms are set and before concrete is poured. Core drilling openings shall have a sleeve caulked and grouted in place.

B. All pipes passing through floor, whether slab-on grade or above grade levels, shall be sleeved with sleeve extending 1 in. above floor. This includes all piping in toilet room pipe space, stairwells, closets, partitions and pre-cast planks.

C. All sleeves shall be Schedule 40 galvanized steel and shall be reamed. There shall be a minimum of 1 in. annular space between the sleeve and pipe provide greater clearance where seismic requirements dictate. Sleeves on insulated pipe shall be large enough to allow insulation to pass through sleeve. Sleeves on drywall, masonry, or concrete walls and partitions, shall be flush with wall on both sides.

D. The space between sleeve and pipe in all cases shall be filled with a U.L./F.M. approved caulking compound. This includes pipes concealed in chases and/or partitions.

E. Inserts where required shall be furnished and set by the Plumbing Subcontractor and where necessary may be drilled or power driven and shall be sized such that the insert will not exceed a depth of penetration of 1 in. into concrete.

F. Escutcheons: All exposed pipe, uncovered, passing through walls or floors or ceilings shall be fitted with C.P. brass spun or split type escutcheons with approved clamping device for holding in position. Floor escutcheons shall be deep enough to fit over sleeves, fastened to pipe, and extend down to floor.

3.6 TESTING

A. Test all Work in the presence of the Architect and/or Engineer and as required by Local Codes.

B. After Soil, Storm, Waste, and Vent Piping is in place and before being buried or furred in, plug lower ends and fill the system with water up to the top of stacks. Piping is to be left tight under these conditions and water lever shall be maintained intact for the period of at least four (4) hours.

C. Test all water piping by applying a hydrostatic pressure of 150 PSIG using a pump for this purpose. Make sure that all lines are properly plugged or capped and that air has been vented before applying pressure which shall remain constant without pumping for two (2) hours at least.

D. Test gas piping per State Gas Code.

E. Any leaks in joints or evidence of defective pipe on fittings disclosed by test shall be immediately corrected by replacing defective parts with new joints or materials. No makeshift repair effected by caulking threaded pipe with lead wool, application or Wilky or patented compounds will be permitted.

F. Provide testing report for all systems tested.

3.7 CHLORINATION

A. Upon completion of the Plumbing Work, thoroughly chlorinate the entire domestic water system before putting same in service. Chlorinate all work in the presence of the Architect and/or Engineer. The chlorinating agent shall be as a solution of sodium hypochlorite. Water shall be fed slowly into the new line with chlorine in the proper amount to produce a dosage of 50 PPM. Open and close all valves while system is being chlorinated.

B. After the sterilization agent has been applied for 24 hours, pay for an independent testing agency to test for residual chlorine and for presence of bacteria. A residual of not more than 5 PPM shall be required in all parts of the line.

C. If test show 5 PPM or greater of residual chlorine, flush out system until all traces of the chemical used are removed.

D. Provide testing report from independent testing agency.

3.8 INSTALLATION OF FIRESTOP SYSTEMS

A. General: Install firestop systems at all fire-rated construction where penetrated by the Work of this Section.

B. Refer to Section 078410 - Penetration Firestopping, for all installation requirements for maintaining integrity of fire-rated construction at penetrations.

3.9 SEISMIC RESTRAINTS

A. The independent engineer responsible for design of seismic restraints shall visit the project upon completion of the work to certify the installation is consistent with the approved shop drawings. The certification shall be submitted to the Architect and must precede the closing in of ceilings.

3.10 SYSTEM SHUTDOWNS

A. Coordinate shutdowns of existing systems with the Owner and submit a written request at least ten working days in advance. Minimize system shut downs as much as possible. Submit a list of all affected areas, the proposed work to be performed, and the expected length of the shut-down including time for retesting.

B. Provide temporary services to maintain active system during extended shut-downs as required for demolition and construction phasing.

END OF SECTION

SECTION 230010

HEATING, VENTILATING & AIR-CONDITIONING (HVAC)
(Filed Sub-Bid Required)

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SECTION 230010

HEATING, VENTILATING & AIR-CONDITIONING (HVAC)
(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 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. Time, Manner and Requirements for Submitting Sub-Bids:

1. 1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

The following should appear on the upper left hand corner of the envelope:

NAME OF SUB-BIDDER: (Insert name of sub-bidder)

MASS. STATE PROJECT: ((Insert project number from top of page))

SUB-BID FOR SECTION: 230010 – HVAC

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements:

Class of Work	Section Number
Insulation	2.6, 3.6
Sheetmetal & Accessories	2.16, 2.17, 2.18, 2.19, 2.20, 2.21, 2.22, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21
Vehicle Exhaust System	2.28, 3.27
Automatic Temperature Control	2.39, 3.28
Air & Water Balancing	3.29

If Sub-Bidder intends to perform with persons of his own staff the classes of work listed above, he must nevertheless list his own name therefore, under Paragraph E, of the FORM FOR SUB-BID.

D. The Work of this Section is shown on the following Drawings: M101, M102, M103, M104, M201, M202, M203, M301, M302, M303, M401, M402, M403, M404, VS-1.

1.2 GENERAL REQUIREMENTS

A. Examine all other Sections of the Specifications for requirements that affect work of this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.3 DESCRIPTION OF WORK

A. General:

1. The work described herein shall be interpreted as work to be done by the HVAC Subcontractor. Work to be performed by other trades will always be specifically referenced to that trade.
2. Furnish all staging, rigging, temporary support, labor, materials, and perform all operations in connection with the installation of the HVAC work.
3. The building is to be commissioned and this contractor shall provide all labor required to fully test and demonstrate that all systems operate as designed.

B. Without limiting the generality thereof, the work to be performed under this Section includes:

1. Heating Hot Water Piping System with Insulation, Hangers, Valves, etc.
2. Rooftop Units with Energy Recovery
3. Exhaust Fans
4. Ductwork With Insulation, Hanger, Damper, etc.
5. Electric Unit Heaters and Radiant Panels
6. Mechanical Insulation, Ductwork, Piping, and Equipment
7. Condensate Pumps
8. Direct digital automatic temperature controls.
9. Testing, Adjusting & Balancing of all Ducted and Piped Systems and Equipment
10. Chemical Treatment Systems
11. Equipment Nameplates
12. Factory Tests
13. Seismic Restraints & Vibration Isolation (refer to Section 23 05 48)
14. Diffusers, Registers and Grilles
15. Acoustic Duct Lining
16. Sound Attenuators
17. Refrigerant Piping
18. Roof Curbs
19. High Efficiency Condensing Boilers
20. Ductless Cooling Units
21. Variable Air Volume Boxes
22. Heat Recovery System (VRF)
23. CO/NO2 Detection and Control
24. Electric Terminal Heating Equipment
25. Vehicle Exhaust Equipment
26. Firestopping of all penetrations by this section of fire and smoke rated floors and walls per the requirements of Section 07 84 10
27. Acoustic sealing of all penetrations by this section of non-rated walls per the requirements of Section 07 92 00
28. Furnishing access panels and doors per the requirements of Section 08 31 10 to the GC for installation.
29. Furnishing louvers per the requirements of Section 08 91 00 to the contractor for installation
30. When open-flame or spark producing tools such as blower torches, welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain

constant non-working fire watch through the Local Fire Department where work is being performed and until it is completed.

1.4 DEFINITIONS

A. Most terms used within the documents are industry standard. Certain words or phrases shall be understood to have specific meanings as follows:

B. Provide: Furnish and install completely connected up and in operable condition, ready for the intended use.

C. Furnish: Purchase and deliver to a specific location within the building or site, ready for unloading, unpacking, assembly, installation, and similar operations.

D. Install: With respect to equipment furnished by others, install means to receive, unpack, move into position, mount and connect, including removal of packaging materials.

E. Conduit: Raceways of the metallic type which are not flexible. Specific types as specified.

F. Connect: To wire up, including all branch circuitry, control and disconnection devices so item is complete and ready for operation.

G. 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.

H. General Contractor and Construction Manager are one in the same.

I. Occupied Area(s): Any area within the building envelope and within the scope of work area that is provided with heat, ventilation, or air conditioning.

1.5 RELATED WORK

A. Cutting beyond the requirements as stated herein, refer to SECTION 017329 - Cutting and Patching.

B. For temporary controls refer to SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.

C. For flashing of vents through roof and setting of roof curbs and flashing of such, refer to Section 076200– Sheet Metal Flashing and Trim.

D. For excavation and backfill of below grade mechanical and related systems refer to Division 31.

E. For finished painting of mechanical systems not called for in this Section refer to Section 09 90 00 Painting and Coating.

F. For interior concrete work relating to this Section refer to Section 03 30 00 – CAST-IN-PLACE CONCRETE.

G. For exterior concrete work relating to this Section refer to Section 03 30 00 - CAST-IN-PLACE CONCRETE.

1.6 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

A. Furnish pipe sleeves for placement into formwork by the Generator Contractor, Refer to Section 03 30 00.

B. Access doors and panels: furnish per the requirements of Section 08 31 10 - Access Doors and Frames to the General Contractor for installation.

C. Furnish access panels and doors for installation in walls, ceiling and floors at locations to permit access for adjustment, removal, replacement and servicing of all concealed equipment, valves, volume dampers, materials, etc. installed under this Section of the specifications. Per the requirements of SECTION 08 31 10 – ACCESS DOOR AND FRAMES.

D. Access panels will be installed by the General Contractor.

E. Access panels shall be located in closets, storage rooms and/or other non-public areas if possible, positioned so that the equipment can be easily reached, and the size shall be sufficient for this purpose (min. 16” x 16”). When access panels are required in corridors, lobby or other habitable areas, they will be located as directed by the Owner’s Representative.

1.7 CODES, ORDINANCES, AND PERMITS

A. Perform all work in accordance with the requirements of the Town of North Reading Building Department, State of Massachusetts Building Code, and applicable State and Federal Laws. Give all requisite notices, file all requisite plans, and obtain all permits required to perform HVAC Work. Pay all fees and include in the Bid. All HVAC equipment shall be installed to meet all State, Local and Federal sound ordinances.

B. Refer to GENERAL CONDITIONS for local connection and permit fees and information regarding Utility Company back charges.

C. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.

D. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. No work shall be covered before examination and approval by the Owner’s Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner’s Representative, and without extra cost to the Owner. If work is covered before examination and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.8 QUALITY ASSURANCE

A. Codes and Standards:

1. HI Compliance: Design, manufacture, and install HVAC pumps in accordance with HI Hydraulic Institute Standards".
2. UL Compliance: Design, manufacture, and install HVAC pumps in accordance with UL 779 "Motor Operated Water Pumps".
3. ANSI Standards: Comply with ANSI A13.1 for pipe, valve, and equipment identification.
4. I=B=R Compliance: Provide boilers that have been tested and rated in accordance with Institute of Boiler and Radiator Manufacturers (I=B=R) "Testing and Rating Standard for Cast Iron and Steel Heating Boiler", and bear I=B=R emblem on nameplate affixed to boiler.
5. ASME Compliance: Construct boilers in accordance with ASME Boiler and Pressure Vessel Code, Section IV "Heating Boilers".

6. UL and NEMA Compliance: Provide boiler ancillary electrical components, which have been listed and labeled UL, and comply with NEMA Standards.
7. FM Compliance: Provide control devices and control sequences in accordance with requirements of Factory Mutual System (FM).
8. IRI Compliance: Provided control devices and control sequences in accordance with requirements of Industrial Risk Insurance (IRI).
9. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards.
10. AGA Compliance: Provide gas controls and devices in accordance with American Gas Associates.
11. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models.
12. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
13. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
14. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA standards.
15. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

MSS Standard Practices: Comply with the following standards for valves:

16. MSS SP-45: Bypass and Drain Connection Standard
17. MSS SP-67: Butterfly Valves
18. MSS SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends
19. MSS SP-71: Cast Iron Swing Check Valves, Flanged
20. MSS SP-72: Ball Valves with Flanged or Butt-Welding Ends for General Service
21. MSS SP-78: Cast Iron Plug Valves, Flanged and Threaded Ends
22. MSS SP-80: Bronze Gate, Glove Angle and Check Valves
23. MSS SP-84: Steel Valves - Socket Welding and Threaded Ends
24. MSS SP-85: Cast Iron Globe and Angle Valves, Flanged with Threaded Ends
25. MSS SP-92: MSS Valve User Guide

B. Automatic Temperature Control Contractor Qualifications: Firms specializing in installation of Automatic Temperature control system for not less than 5 years.

1. Codes and Standards:

   a. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.
   b. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
   c. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.9 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, advise Architect in writing before Award of Contract. Otherwise, Architect’s interpretation of Contract Documents shall be final, and no additional compensation shall be permitted.

B. Where Drawings or Specifications do not coincide with manufacturer’s recommendations, or with applicable codes and standards, alert Architect in writing before installation.

C. Of the required material, installation, or work can be interpreted differently from drawing to drawing, for between drawings and specs, this contractor shall provide that material, installation, or work which is of the more stringent.

D. It is the intent of these contract documents to have the contractor provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a system. In cases such as this, where the contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner.

1.10 CONTRACT DRAWINGS

A. All work shown on the Drawings and BIM models provided to the contractor is intended to be approximately correct to scale, but shall be taken in a sense as diagrammatic. Sizes of ductwork and pipes and general method of running them are shown, but it is not intended to show every offset and fitting which is only possible after final coordination with all sub-contractors and submission of coordination drawings. No additional compensation will be allowed for offsets and fittings not specifically shown of the contract drawings. To carry out the true intent and purpose of the plans, furnish all necessary parts to make complete working systems ready for use.

B. The HVAC Drawings and Specifications are intended to supplement each other so that any details shown on the Drawings and not mentioned in the Specifications, or vice-versa, shall be executed the same as if mentioned in the Specifications and shown on the Drawings.

C. Refer to the Architectural, Structural, Plumbing, Mechanical and Electrical Drawings which indicate the construction in which this work shall be installed. Locations shown on the plans shall be checked against the general and detailed Drawings of the construction proper. All measurements must be taken at the building.

1.11 COORDINATION DRAWINGS

A. Before materials are purchased or Work is begun, prepare and submit to the Architect, Coordination Drawings showing the size and location of all equipment and piping lines relevant to the complete system. Ensure that these Drawings are compatible and correctly annotated and cross-referenced at their interfaces.

B. Coordination Drawings are for the Contractor's and the Architect's use during Construction and shall not be construed as replacing any Shop or Record Drawings required elsewhere in these Contract Documents.

C. Detailed procedures for Coordination Drawings are contained in SECTION 013100 - Project Management and Coordination of these Contract Documents.

1.12 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for service and removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

1.13 ROUGH IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. This Sub-contractor shall disconnect, lower to floor, and stack near-by all noted mechanical systems being removed. The General Contractor shall remove from the building and dispose of in a legal manner.

1.14 NOTIFICATION OF RELATED TRADES

A. Notify all other trades responsible for installing chases, inserts, sleeves, anchors, louvers, etc. when ready for such installation and for final checking immediately before concrete is placed. Cooperate with such trades to obtain proper installation.

B. Leave openings in walls for pipes, ducts, etc. for mechanical and electrical work as shown on Drawings or required by layout of mechanical or electrical systems.

1.15 MECHANICAL INSTALLATIONS

A. Coordinate mechanical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

G. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

H. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

I. Coordinate connection of mechanical system with overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

J. Installation of Louvers shall be witnessed by the General contractor.

1.16 CUTTING AND PATCHING

A. Drilling, coring, cutting, and patching of structures (through walls, floors, ceiling, etc.) where the largest dimension does not exceed 12" shall be by this Contractor.

B. Throughout the performance of the cutting and coring work, ensure that the structural integrity of walls, floors, overhead structure, and other structural components, which are to remain, is maintained

until permanent work is installed. Prior to any coring or cutting verify all locations of same with the General Contractor. All cutting and coring is to be performed in accordance with approved coordination drawings. All cutting or coring of structural must receive approval of the Architect prior to proceeding.

C. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

D. Refer to Section 017329 - Cutting and Patching for additional requirements related to cutting and patching

1.17 SUBMITTALS

A. Refer to SECTION 013300 - Submittal Procedures for submittal definitions, requirements, and procedures. The following paragraphs supplement the requirements of Section 01 33 00.

B. Submittal of Shop Drawings, product data, and samples will be accepted only when submitted by the General Contractor. Data submitted by Sub-contractors and material suppliers directly to the Architect/Engineer will not be processed. Submittals will be electronic unless physical sample are required.

C. Provide submittals for the following equipment:

1. Valves
2. Meters and Gauges
3. Hangers and Attachments
4. Mechanical Identification
5. Mechanical Insulation
6. Refrigerant Piping
7. Condensate Pumps
8. Terminal Heating Units (electric, gas, hot water)
9. Rooftop Units with Energy Recovery
10. CO/NO2 Detection and Control
11. Power and Gravity Ventilators
12. Metal Ductwork
13. Ductwork Accessories
14. Air Outlets and Inlets
15. Heat Recovery Systems (VRF)
16. Variable Air Volume Boxes
17. Ductless Cooling Units
18. Automatic Temperature Controls
19. Air and Water Testing and Balancing
20. Acoustic Liner
21. Sound Attenuators
22. Vehicle Exhaust System
23. Louvers: see section 081110
24. Firestopping of penetrations required for the work of this section: see section 07 84 10
25. Acoustic sealant at penetrations of non-rated walls- see section 07 92 00.
26. Access doors and panels - see Section 08 31 10.

D. If a Shop Drawing is not accepted after two submissions, a third submission from the same manufacturer will not be considered.

E. Check Shop Drawings and other submittals to assure compliance with contract documents before submittal to A/E.

F. Review of Shop Drawings is final and no further changes shall be considered without written application. Shop Drawings review does not apply to quantities, nor relieve this Contractor of his responsibility for furnishing materials or performing his work in full compliance with these Contract Drawings and Specifications. Review of these shop drawings shall not be considered a guarantee of the measurements of this building or the conditions encountered.

1.18 SUBSTITUTIONS

A. Refer to, Section 013300- Submittal Procedures for requirements in requesting substitutions. The following paragraphs supplement the requirements of Section 013300.

B. If materials or equipment are substituted for specified items that alter the systems shown or its physical characteristics, or which have different operating characteristics, clearly note the alterations or difference and call it to the attention of the a/e. Under no circumstances shall substitutions be made unless material or equipment has been successfully operated for at least three consecutive years.

C. Any modifications to the design, as a result of approving a substitution, shall be the responsibility of this contractor. Any additional cost to this contractor or any other contractor, directly or indirectly, as a result of such substitutions, shall be the responsibility of this contractor.

1.19 PRODUCT LISTING

A. Prepare listing of major mechanical equipment and materials for the project.

B. Provide all necessary information.

C. Submit to the A/E through the General Contractor, within twenty (20) days of signing contract, this listing indicating all equipment and manufacturers, as a part of the submittal requirement. If the product list is not submitted, it will be the responsibility of the sub-contractor to submit one (1) of the three (3) named equal manufacturers.

D. When two or more items of same material or equipment are required they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in work, except as otherwise indicated.

E. Provide products, which are compatible within systems and other connected items.

1.20 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, mode, number, serial number, capacity, operating, and power characteristics labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

1.21 DELIVERY, STORAGE AND HANDLING

A. Refer to General Conditions and Division 01 sections for delivery, storage, and handling of equipment. The following paragraphs supplement the requirements of General Conditions.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Store equipment and materials off-site. Protect stored equipment and materials from damage.

D. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.22 RECORD DOCUMENTS

A. Refer to Division 01 for requirements for record documents. The following paragraphs supplement the above.

B. Provide electronic AutoCAD/Revit drawings/models as required by architectural general conditions requirements. Modify electronic Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column line; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located. Also provide ATC Drawings showing As-Built conditions indicating point to point wiring from field devices to the control panels as well as floor plans indicating actual controller locations and communication wiring routes, modified sequences, field changes and any additional HVAC items added through change orders, ASI & RFI.

1.23 OPERATION AND MAINTENANCE DATA

A. Refer to Sections 017700 - Closeout Procedures and 017839 - Project Record Documents for procedures and requirements for preparation and submittal of maintenance manuals. The following paragraphs supplement the requirements of Section 017700 and 017839.

B. In addition to the information required by Section 017700 and 017839 for maintenance data, include the following information:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and user summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and trouble-shooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Provide USB video recording of operation and maintenance training sessions and include as part of O & M Manual submittal. Provide indexed table of contents for USB recording.
6. ATC Drawings/Submittal of As-Built conditions including building CAT6 wiring, field devices, controllers, etc. for a complete as built condition.

1.24 WARRANTIES

A. The contractor shall provide a one (1) year minimum warrantee on all product (unless otherwise stated in the product specification for a specific product) and labor for work under this section.

B. Refer to Section General Conditions and Division 01 for additional procedures and submittal requirements for warranties.

C. In addition to the one year warranty period against component and/or workmanship defects, the 40 hours of training and the 40 hours of extra programming as it relates to the control system and as indicated in section 23 00 10 paragraph 2.29 & 3.29, the ATC contractor shall provide a seasonal site visit to confirm, verify and modify as required the sequence and/or programming of each piece of equipment to ensure the system is functioning as required and per the sequence of operations. The ATC contractor shall provide 16 labor hours per season (four times within a year, total of 64

hours). During each visit they shall, for each piece of equipment confirm operation and functionality, modify and/or repair any control related issues and/or programming and provide training as requested by the owner. This requirement will ensure the equipment/building is operating properly and efficiently as it cycles through each season. These seasonal site visits shall begin the following season after substantial completion of the project is issued. Upon substantial completion the HVAC contractor shall issue four dates to the engineer of record and owner. Signatures and time logs will be kept by both parties to ensure these visits occur.

1.25 WELDING QUALIFICATIONS

A. Piping shall be welded in accordance with qualifications procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operations qualified by another employer may be accepted as permitted by ASME B31.1. The Owner's Representative shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Division 01.

B. When open-flame or spark producing tools such as welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain constant fire watch/fire detail (by the North Reading Fire Department) where work is being performed and until it is completed. This Contractor shall be responsible for obtaining required permit and paying all permit fees and Firewatch detail expenses.

1.26 TRADE RESPONSIBILITY COORDINATION MATRIX

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
Smoke Detectors (Area type)	26 00 10	26 00 10	26 00 10	23 00 10 (ATC)	26 00 10	
Smoke & Fire/Smoke Dampers	23 00 10	23 00 10	N/A	N/A	N/A	
Smoke & Fire/Smoke Damper Actuators	23 00 10	23 00 10	26 00 10 & 23 00 10 (ATC)	23 00 10 (ATC)	26 00 10	2
Fire Dampers	23 00 10	23 00 10	N/A	N/A	N/A	
Hydronic Control Valves	23 00 10 (ATC)	23 00 10	N/A	23 00 10 (ATC)	N/A	1
Hydronic Control Valve Actuator	23 00 10 (ATC)	23 00 10 (ATC)	23 00 10 (ATC)	23 00 10 (ATC)	N/A	1
Sheet Metal Damper	23 00 10	23 00 10	N/A	N/A	N/A	1
Sheet Metal Damper Actuators	23 00 10 (ATC)	23 00 10 (ATC)	23 00 10 (ATC)	23 00 10 (ATC)	N/A	1
Natural Gas Energy Meters	22 00 10	22 00 10	26 00 10 & 23 00 10 (ATC)	23 00 10 (ATC)	N/A	3
Electrical Energy Meters	26 00 10	26 00 10	26 00 10 & 23 00 10 (ATC)	23 00 10 (ATC)	N/A	3
Domestic Water Meters	22 00 10	22 00 10	26 00 10 & 23 00 10 (ATC)	23 00 10 (ATC)	N/A	3

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
HVAC Hydronic Energy Meters	23 00 10	23 00 10 (ATC)	26 00 10 & 23 00 10 (ATC)	23 00 10 (ATC)	N/A	3
DDC Panels	23 00 10 (ATC)	23 00 10 (ATC)	26 00 10 & 23 00 10 (ATC)	23 00 10 (ATC)	N/A	4
VFDs at Pumps	26 00 10	26 00 10	26 00 10	23 00 10 (ATC)	N/A	
Boiler/DHW Intake & Exhaust Breeching	22 00 10	22 00 10	N/A	N/A	N/A	
Generator Exhaust Breeching	22 00 10 (if gas fired) 23 00 10 (if diesel fired)	22 00 10 (if gas fired) 23 00 10 (if diesel fired)	26 00 10	26 00 10	26 00 10	
Kitchen Emergency Gas Valve	22 00 10	22 00 10	26 00 10	26 00 10	26 00 10	

Notes:

1. Division 23 00 10 and Division 23 00 10 (ATC) Contractors shall fully coordinate all airflow damper and hydronic valves sizes and quantities.
2. Smoke Damper and VAV Box power wiring shall be provided by Division 26 00 10 to junction box locations shown on electrical drawings; Division 23 00 10 (ATC) Contractor shall provide final power wiring from junction box to end device location.
3. Division 26 00 10 Contractor shall provide all line-voltage power wiring required for meters; Division 23 00 10 (ATC) Contractor shall provide all low-voltage power wiring required for meters.
4. Division 26 00 10 shall provide power at main DDC Panel. Division 23 00 10 (ATC) shall provide power to all other DDC Panels.

1.27 ENERGY REBATE PROGRAM

A. This project has been designed to incorporate equipment approved for energy rebate such as boilers, high efficiency motors, rooftop units and heat recovery units. HVAC subcontractor shall review Utility Company requirements prior to submitting shop drawing to ascertain that submittal meets program guidelines. All submitted equipment shall meet utility company rebate program efficiency requirements. HVAC subcontractor shall furnish equipment submittals, related equipment/system pricing data and all required rebate application information, and forms to utility company.

1.28 HAZARDOUS MATERIALS

A. The HVAC Sub-contractor shall be responsible for removing and legally disposing of any and all hazardous waste associated with HVAC systems, including but not limited to:

1. All chemical treatment used in flushing out HVAC piping systems.
2. Un-used excess material such as adhesives used in ductwork and piping installations.
3. Refrigerant in all AC systems.
4. Propylene Glycol (where applicable)
5. Items specifically noted on drawings.

1.29 HOISTING EQUIPMENT AND MACHINERY

A. Unless otherwise specified, all hoisting and rigging equipment and machinery required for the proper and expeditious prosecution and progress of the Work of this Section shall be furnished, installed, operated and maintained in safe condition by each sub-contractor, as specified under Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.

1.30 STAGING AND SCAFFOLDING

A. Unless otherwise specified, each sub-contractor shall provide all lifts and man-lifts, and furnish, erect and maintain in safe condition, all staging and scaffolding as specified under Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS, as needed for proper execution of the work of this Section. Staging and scaffolding shall be of adequate design, erected and removed by experienced stage builders having all accident prevention devices required by Federal, state and local laws.

PART 2 - PRODUCTS

2.1 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

A. Pursuant to Massachusetts General Laws Chapter 141, a Massachusetts Licensed electrician shall install all low voltage wiring required by this section.

B. General: The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. All motors for all mechanical equipment shall be NEMA premium efficiency matching the following and all motors associated with variable frequencies drives shall be inverted duty motor with Aegis bearing protection rings:

HP	RPM	Efficiency
1	1800	85.5 percent
1.5	1800	86.5 percent
2	1800	86.5 percent
3	1800	89.5 percent
5	1800	89.5 percent
7.5	1800	91.0 percent
10	1800	91.7 percent
15	1800	93.0 percent
20	1800	93.0 percent
25	1800	93.6 percent
30	1800	94.1 percent
40	1800	94.1 percent
50	1800	94.5 percent

2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
4. Temperature Rating: Rated for 40 degrees C. environment with maximum 50 degrees C temperature rise for continuous duty at full load (Class F Insulation). All ratings shall be for inverter duty applications.
5. Starting Capability: Frequency of starts as indicated by automatic control system and not less than five evenly time spaced starts per hour for manually controlled motors.
6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
7. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
8. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
9. Bearings:

a. Ball or roller bearings with inner and outer shaft seals.
b. Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
c. Designed to resist thrust loading where belt drivers or other drives produce lateral or axial thrust in motor.
d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.

10. Enclosure Type:

a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
c. Weather protected Type I for outdoor use, Type II where not housed.

11. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
12. Noise Rating: "Quiet".
13. Efficiency: "Premium Efficient" motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, Test Method B.
14. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
15. Provide AEGIS magnetic bearing protection ring for all inverter rated motors that are controlled by variable speed drives. The bearing protection ring shall channel harmful shaft voltages to ground to protect bearing races from pitting.

C. Starters, Electrical Devices, And Wiring: (Provided By The HVAC Subcontractor For Each Packaged Piece Of HVAC Equipment Requiring Such):

1. Motor Starter Characteristics:

a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.
b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

2. Manual Switches shall have:

a. Pilot lights and extra position for multi-speed motors.
b. Overload Protection: Melting alloy type thermal overload relays.

3. Magnetic Starters:

a. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
b. Trip-free thermal overload relays, each phase.
c. Interlocks, pneumatic switches and similar devices as required for co-ordination with control requirements of Division 23 Controls Sections.
d. Built-in 120 volts control circuit transformer, fused from line side, where service exceeds 240 volts.
e. Externally operated manual reset.
f. Under-voltage release or protection.

4. Capacitors:

a. Individual unit cells.
b. All welded steel housing.
c. Each capacitor internally fused.
d. Non-flammable synthetic liquid impregnant.
e. Craft tissue insulation.
f. Aluminum foil electrodes.
g. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors one horsepower and larger, that have an uncorrected power factor of less than 85 percent at rated load.

5. Disconnect Switches:

a. Fusible Switches: Fused, each phase; general duty; horsepower rated; non-teasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.
b. Non-fusible Switches: For equipment two horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment larger than two horsepower, switches shall be the same as fusible type.

2.2 VALVES

A. General:

1. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.
2. Valves shall have rising stem, or rising outside screw and yoke stems; except, non-rising stem valves may be used where headroom prevents full extension of rising stems.
3. Pressure and temperature ratings shall be as required to suit system pressures and temperatures.
4. Unless otherwise indicated, provide valves of same size as upstream pipe size. Automatic control valves shall be sized by the ATC Contractor and shall not exceed a 3 PSI drop.
5. Provide the following special operator features:

a. Handwheels fastened to valve stem, for valves other than quarter turn, by brass nut on a square-topped stem.
b. Lever handle on quarter-turn valves 6" and smaller, except for plug valves. Provide one wrench for every 10 plug valves, and one year’s supply of recommended lubricant and sealant.
c. Chain-wheel operators for valves 2-1/2" and larger installed 72" or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
d. Gear drive operators on quarter-turn valves 8" and larger.

6. Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
7. Bypass and drain connections shall comply with MSS SP-45.
8. End connections shall be as specified in the individual valves specifications.

a. Threads: Comply with ANSI B2.1.
b. Flanges: Comply with ANSI B16.1 for cast iron ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

9. Solder-Joint: Comply with ANSI B16.18.
Caution: Where soldered end connection are used, use solder having a melting point below 840° F. for gate, globe, and check valves; below 421° F. for ball valves.

B. Gate Valves:

1. Gate Valves (Heating Hot Water) - 2" and smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze, threaded ends, solid disc, bronze alloy stem with less than 6% zinc content, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

	THREADED	
MANUFACTURER	NRS	RS
Crane:	x	431UB
Jenkins:	x	47CU
Lunkenheimer:	x	3151
Nibco:	T-136	T-134
Stockham:	B-130	B-120
Milwaukee:	141M	1151M

2. Gate Valves (Heating Hot Water) 2-1/2" and larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B, flanged ends, and "Teflon" impregnated packing and two-piece backing gland assembly.

MANUFACTURER	OS&Y RS	NRS
Crane:	465-1/2	461
Jenkins:	651C	326C
Lunkenheimer:	1430	1428
Nibco:	F-617-0	F-619
Stockham:	G-623	G-612
Milwaukee:	F-2885-M	F-2882-M

C. Ball Valves:

1. Ball Valves (Heating Hot Water) 1" and smaller: Rated for 150 psi saturated steam pressure, 600 psi WOG pressure, 2-piece construction, bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide threaded ends for heating hot water, soldered for chilled water.

	THREADED	SOLDER
MANUFACTURER	ENDS	ENDS
Milwaukee:	BA-100	BA-150
Conbraco (Apollo)	70-100	70-200
Crane:	9302	9322
Jamesbury:	21-1000TT	x
Jenkins:	900A	902A
Lukenheimer:	AQ311	x
Nibco:	T-585	S-585
Watts:	B-6000	B-6001
Stockham:	S-216 BR-R-T	S-216 BR-R-S

2. Ball Valves (Heating Hot Water) 1-1/4" to 2": Rated for 150 psi saturated steam pressure, 600 psi WOG pressure; 3-piece construction, bronze body conforming to ASTM B 62, conventional port, chrome-plated brass ball, replaceable
"Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide threaded ends for heating hot water, soldered for chilled.

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Milwaukee:	BA-300	BA-350
Conbraco (Apollo):	82-100	82-200
Nibco:	T-595-Y	\S-595-Y
Watts:	B-6800	B-6801
Stockham:	S-216 BR-R-T	S-216 BR-R-T

For grooved end connections use Victaulic Style 721.

D. Plug Valves:

1. Plug Valves - 2" and smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.

MANUFACTURER	
Rockwell:	214.
Lunkenheimer:	454.
Crane:	250.

2. Plug Valves - 2-1/2" and larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

MANUFACTURER	
Rockwell:	305.
Nordstrom:	143.
Serck-Audco:	LSW-133-GG.
Homestead:	612.

(8" and larger to be Gear Operated).

E. Globe Valves:

1. Globe Valves (Heating Hot Water) - 2" and smaller: MSS Sp-80; Class 150, body and union bonnet of ASTM B 62 cast bronze, threaded ends, brass or replaceable composition disc, bronze alloy stem with less than 6% zinc content, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

MANUFACTURER	
Jenkins:	106-B.
Lunkenheimer:	407.
Nibco:	T-235-Y.
Stockham:	B-22.

2. Globe Valves (Heating Hot Water) - 2-1/2" and larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing and two-piece backing gland assembly.

MANUFACTURER	STRAIGHT BODY	ANGLE BODY
Milwaukee:	F-2981-M	x
Crane:	351	353
Jenkins:	613C	x
Lunkenheimer:	1123	x
Nibco:	F-718-B	x
Stockham:	G-512	G-515

F. Butterfly Valves:

1. Butterfly Valves (Heating Hot Water) - 2-1/2" and larger: MSS SP-67; 200 psi, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with aluminum bronze disc, stainless steel, and EPDM 0-ring stem seals. Sizes 2 through 6" shall have lever operators with locks, and sizes 8 through 24" shall have gear operators with position indicator. Valves on dead end service or requiring additional body strength shall be lug-wafer type, drilled and tapped.

MANUFACTURER	WAFER	
	LEVER	GEAR
Milwaukee:	x	MW-123-E
Center Line:	x	Series A
Crane:	42	x
Keystone:	100	x
Nibco:	WD-20003	WD-20003
Stockham:	LG-512-BS3E	LG-522-BS3E
	LUG	
	LEVER	GEAR
Milwaukee:	x	ML-123-E
Center Line:	x	Series LT
Crane:	44	x
Keystone:	129	x
Nibco:	LD-20003	LD-20005
Stockham:	LG-712-BS3E	LG-722-BS3E
Grooved Ends:	Victaulic Series 704.	

G. Check Valves:

1. Swing Check Valves (Heating Hot Water) - 2" and smaller: MSS SP-80; Class 150, cast bronze body and cap, conforming to ASTM B 62, horizontal swing, with a Teflon disc, and having threaded ends. Valve shall be capable of being repaired while the valve remains in the line.

MANUFACTURER	
Milwaukee:	510T
Crane:	x
Jenkins:	352C
Lunkenheimer:	230-70
Nibco:	T-433-Y
Stockham:	B-321

For grooved connections us Victaulic Series 712.

2. Swing Check Valves (Heating Hot Water) - 2-1/2" and larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

MANUFACTURER	CLASS 125	CLASS 175
Milwaukee:	F-2974-M	x
Crane:	373	375
Jenkins:	624C	477
Lunkenheimer:	1790	x
Nibco:	F-918B	x
Stockham:	G-931	G-940

3. Wafer Check Valves (Heating Hot Water) - (Non-Slam): Class 250, cast iron body, replaceable lapped bronze seat, lapped and balanced twin bronze flappers and stainless steel trim. Valve shall be designed to open and close at approximately one foot differential pressure. Twin flappers shall be loaded with a stainless steel torsion spring to minimize flapper drag and assure even non-slam checking action.

MANUFACTURER	
Milwaukee:	1400-2C
Center Line:	CLC
Metraflex:	hexx
Mission:	12HMP
Stockham:	WG970

For grooved connection use Victaulic Series 710 and 711.

4. Lift Check Valves - 2" and smaller: Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal, lift type valve, bronze disc and threaded ends. Valve shall be capable of being refitted and ground while the valve remains in the line.

MANUFACTURER	HORIZONTAL
Milwaukee:	544
Hammond:	901
Jenkins:	17C
Lunkenheimer:	142

H. Coil Pak – Manual Flow Control: Contractor shall provide and install manual flow control coil piping packages at all locations as detailed in the construction documents from sizes ½” -2-1/2”.

1. Coil Paks shall be designed for a minimum 600 PSIG WOG working pressure for sizes ½” through 2½” and up to 325 degrees F.
2. Each Coil Pak is to include an UltraMB™ combination manual flow control valve, dual isolation valve, and integral union with (2) pressure & temperature test plugs; UltraY™ combination y-strainer, isolation valve, blow down / drain valve, and union with (1) pressure and temperature test plug; UltraU™ accessory port union with (1) manual air vent and (1) pressure and temperature test plug.
3. Each Coil Pak shall be “Bagged & Tagged” for easy identification and storage.
4. Extended pressure and temperature test plugs, manual air vents and handles shall be available. Extended handles shall not break the vapor barrier when operated.
5. Coil Paks shall be available with NPT,SWT,PRESS or PUSH connections and carry a 5 Year product warranty.
6. Approved Manufacturers:

    a. Nexus Valve, Inc.
    b. Tour Anderson
    c. Hays
    d. Or equal

2.3 METERS AND GAUGES

A. Glass Thermometers:

1. General: Provide glass thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
2. Case: Die cast aluminum finished in baked epoxy enamel, glass front, spring secured, 9" long.
3. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.
4. Tube and Capillary: Blue Spirit filled, magnifying lens, 1% scale range accuracy, shock mounted.
5. Scale: Satin faced, non-reflective aluminum, permanently etched markings.

6. Stem: Copper-plated steel, or brass, for separable socket, length to suit installation.
7. Range: Conform to the following:

    a. Hot Water: 30° - 240° F. with 5° F. scale.

8. Manufacturer: Subject to compliance with requirements, provide glass thermometers of one of the following:

    a. Ernst Gage Co.
    b. Marshalltown Instruments, Inc.
    c. Trerice (H.O.) Co.
    d. Weis Instruments, Inc.
    e. Or equal

B. Thermometer Wells:

1. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.
2. Manufacturer: Same as thermometers.

C. Pressure Gauges:

1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
2. Type: General use, 1% accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection.
3. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.
4. Connector: Brass with 1/4" male NPT. Provide protective siphon when used for steam service.
5. Scale: White coated aluminum, with permanently etched markings.
6. Range: Conform to the following:

    a. Water: 0 - 100 psi.

    50 - 300 psi.

7. Manufacturer: Subject to compliance with requirements, provide pressure gauges of one of the following:

    a. Ametek/U.S. Gauge.
    b. Marsh Instrument Co., Unit of General Signal.
    c. Marshalltown Instruments, Inc.
    d. Trerice (H.O.) Co.
    e. Weiss Instruments, Inc.
    f. Or equal

D. Pressure Gauge Cocks:

1. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Construct gauge cock of brass with 1/4" female NPT on each end, and "T" handle brass plug.
2. Siphon: 1/4" straight coil constructed of brass tubing with 1/4" male NPT on each end.
3. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
4. Manufacturer: Same as for pressure gauges.

E. Annular Element Flow Meters and Fittings:

1. General: Provide as indicated, flow metering elements constructed of brass and stainless steel, equipped with readout valves to facilitate connecting of differential pressure meter to flow meter. Equip each readout valve with integral shut-off valve designed to minimize system fluid loss during monitoring process. Provide ball type brass isolation valve. Provide calibrated nameplate with flow meter detailing its flow range through range of differential head pressures. Each element shall be of the bi-directional type having four diametrically opposed sensing ports on both upstream and downstream sides in order to ensure average velocity and static pressure. Elements shall be capable of operating at a maximum temperature of 300° F. and maximum pressure of 250 psig.
2. Manufacturer: Subject to compliance with requirements, provide flow meters of one of the following:

   a. Preso Industries Corp.
   b. Meriam Instrument.
   c. Dieterich Standard Corp.
   d. Or equal

F. Calibrated Balance Valves:

1. General: Provide as indicated, calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate to indicated degree of closure of precision machined orifice. Construct balancing valve with internal EPT 0-ring seals to prevent leakage around rotating element. Provide balance valves with preformed polyurethane insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.
2. Manufacturer: Subject to compliance with requirements, provide calibrated balance valves of one of the following:

   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Taco, Inc.
   c. Armstrong Pumps Inc.
   d. Or equal

2.4 HANGERS AND ATTACHMENTS

A. Horizontal-Piping Hangers and Supports:

1. General: Except as otherwise indicated, provide factory-fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacture for each piping service. Select size of hangers and supports to exactly fit pip size for bare piping, and to insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

   a. Adjustable Steel Clevises Hangers: MSS Type 1.
   b. Steel Pipe Clamps: MSS Type 4.
   c. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

      1) Plate: Unguided type.
      2) Plate: Guided type.
      3) Plate: Hold-down clamp type.

d. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.
e. Pipe Stanchion Saddles: MSS Tube 37, including steel pip base support and cast-iron floor flange.
f. Adjustable Pipe Saddle Supports: MSS Type 38, including steelpipe base support and cast-iron floor flange.
g. Single Pipe Rolls: MSS Type 41.
h. Adjustable Roller Hangers: MSS Type 43.
i. Pipe Roll Stands: MSS Type 44.
j. Pipe Rolls and Plates: MSS Type 45.
k. Adjustable Pipe Roll Stands: MSS Type 46.

2. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

a. Carpenter and Patterson, Inc.
b. Corner & Lada Co., Inc.
c. Elcen Metal Products Co.
d. Fee & Mason Mfg. Co.; Div. Figgie International
e. ITT Grinnel Corp.
f. Or equal

B. Vertical-Piping Clamps:

1. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps, complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

a. Two-Bolt Riser Clamps: MSS Type 8.
b. Four-Bolt Riser Clamps: MSS Type 42.

2. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

a. Carpenter and Patterson, Inc.
b. Corner & Lada Co., Inc.
c. Elcen Metal Products Co.
d. Fee & Mason Mfg. Co.; Div. Figgie International
e. ITT Grinnel Corp.
f. Or equal

C. Hanger-Rod Attachments:

1. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-pipe hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

a. Steel Turnbuckles: MSS Type 13.
b. Swivel Turnbuckles: MSS Type 15.
c. Malleable Iron Sockets: MSS Type 16.

2. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

    a. Carpenter and Patterson, Inc.
    b. Corner & Lada Co., Inc.
    c. Elcen Metal Products Co.
    d. Fee & Mason Mfg. Co.; Div. Figgie International
    e. ITT Grinnel Corp.
    f. Or equal

D. Building Attachments:

1. General: Except as otherwise indicate, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

    a. Concrete Inserts: MSS Type 18.
    b. Top Beam C-Clamp: MSS Type 19.
    c. Side Beam or Channel Clamps: MSS Type 20.
    d. Center Beam Clamps: MSS Type 21.
    e. Welded Beam Attachments: MSS Type 22.
    f. C-Clamps: MSS Type 23.
    g. Top Beam Clamps: MSS Type 25.
    h. Side Beam Clamps: MSS Type 27.
    i. Steel Beam Clamps W/Eye Nut: MSS Type 28.
    j. Linked Steel Clamps W/Eye Nut: MSS Type 29.
    k. Malleable Beam Clamps: MSS Type 30.
    l. Steel Brackets: One of the following for indicated loading:

        1) Light Duty: MSS Type 31.
        2) Medium Duty: MSS Type 32.
        3) Heavy Duty: MSS Type 33.

    m. Side Beam Brackets: MSS Type 34.
    n. Plate Lugs: MSS Type 57.
    o. Horizontal Travelers: MSS Type 58.
    p. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

        1) Carpenter and Patterson, Inc.
        2) Corner & Lada Co., Inc.
        3) Elcen Metal Products Co.
        4) Fee & Mason Mfg. Co.; Div. Figgie International
        5) ITT Grinnel Corp.
        6) Or equal

E. Saddles and Shields:

1. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
2. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

4. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

    a. Elcen Metal Products Co.
    b. Pipe Shields, Inc.
    c. Carpenter Patterson, Inc.
    d. ITT Grinnel Corp.
    e. Or equal

F. Miscellaneous Materials:

1. Metal Framing: Provide products complying with NEMA STD ML 1.
2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A 36.
3. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
4. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
5. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section uter cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.5 MECHANICAL IDENTIFICATION

A. Plastic Pipe Markers:

1. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1
2. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1
3. Insulation: Furnish 1 in. thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2 in. beyond each end of plastic pipe marker.
4. Small Pipes: For external diameters less than 6 in. (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

    a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
    b. Adhesive lap joint in pipe marker overlap.
    c. Laminated or bonded application of pipe marker to pipe (or insulation).
    d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 in. wide; full circle at both ends of pipe marker, tape lapped 1-1/2 in.

B. Application: Provide pipe labels for the following piping system:

1. Heating Hot water supply and return.
2. Refrigerant liquid and suction.
3. Condensate drain.

C. Valve Tags:

1. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4 in. high letters and sequenced valve numbers 1/2 in. high, and with 5/32 in. hole for fastener.

   a. Provide 1-1/2 in. diameter tags, except as otherwise indicated.
   b. Provide size and shape as specified or scheduled for each piping system.
   c. Fill tag engraving with black enamel.

2. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Valve Schedule Frames:

1. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

E. Plastic Equipment Markers:

1. General: Provide manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:

   a. Green: Cooling equipment and components.
   b. Yellow: Heating equipment and components.
   c. Yellow/Green: Combination cooling and heating equipment and components.
   d. Blue: Equipment and components that do not meet any of the above criteria.

2. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

   a. Equipment label “ID” from schedules.
   b. Design capacity from schedules.

3. Size: Provide approximate 2-1/2 in. x 6 in. markers for each piece of equipment.
4. Application: Provide equipment labels for the following equipment:

   a. Expansion Tanks
   b. Rooftop Units (RTU)
   c. Exhaust Fans
   d. Air Cooled Condensing Units
   e. Terminal Heating Units equipped with fans
   f. Ductless Cooling Unit Systems (locate on inside panel)
   g. Glycol Feeder
   h. Air Seperator
   i. Variable Air Volume Boxes (VAV)
   j. Heat Recovery Unit (located on inside panel)
   k. CO/NO2 Detection sensors & Controller

F. Ductwork Labels:

1. Provide painted stencils or standard laminated plastic, color coded labels for the following systems:

a. Supply Ductwork
b. Return Ductwork
c. Exhaust Ductwork
d. Hazardous Exhaust
e. Outside Air Ductwork

2.6 MECHANICAL INSULATION

A. Piping Insulation Materials:

1. Glass Wool Piping Insulation:

a. Manufacturers:

1) Knauf Insulation; Earthwool 1000° Pipe Insulation with ECOSE Technology
2) Knauf Insulation; Earthwool Redi-Klad 1000° Pipe Insulation with ECOSE Technology
3) Or similar as manufactured by Johns Manville, Manson, or Owens Corning

(a) UL/ULC Classified per UL 723 or FHC 25/50 per ASTM E 84; EPD Certified by UL Environment; Living Building Challenge – Declare Red List Free for unjacketed Earthwool Pipe and composite Redi-Klad Pipe; meeting ASTM C 547, Type IV (1000° F.) or Type I (850° F.) ; ASTM C 585; ASTM C 411 and ASTM C 795; Verified to be formaldehyde free by UL Environment.

b. Vapor Retarder Jacket: ASJ+/SSL+ conforming to ASTM C 1136 Type I,II, III, IV, &VIII secured with self-sealing longitudinal laps and matching butt strips.
c. Redi-Klad Jacket: VentureClad 5-ply weather and abuse resistant with self-sealing lap. Zero permeability per ASTM E 96-05; puncture resistance 35.4 kg (189.3 N) per ASTM D 1000; tear strength 4.3 lb (19.4 N) per ASTM D 624; thickness 14.5 mils (0.0145”); tensile strength 68 lb/inch width [306 N (32 kg)/25 mm]

2. Flexible Unicellular Piping Insulation: ASTM C 534, Type as required.

a. Type I - tubular; Type II - sheet. For use between -40 degrees F and 200 degrees F.

3. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations.
4. Encase straight pipe insulation, where exposed in occupied areas, using Redi-Klad Pipe Insulation or cover “standard” insulation with one piece 20-mil thick PVC Jacketing. Fasten and seal as per manufacturer's recommendations.
5. Encase exterior piping insulation using Redi-Klad Pipe Insulation or cover “standard” insulation with aluminum jacket with weather-proof construction.
6. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.
7. Adhesives, Sealants and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

B. Piping Insulation Application and Thickness:

1. Application: Cold Piping (40 Degrees F to Ambient):

a. Insulate the following cold HVAC piping systems:

1) Air conditioner condensate drain piping.
2) Refrigerant liquid and suction piping.

b. znsulate piping system specified above with the following type and thickness of insulation:

1) Glass Wool: 1-1/2 in. thick for all pipe sizes.
2) Flexible Unicellular: (Refrigerant piping only) 1 in. thick.

2. Application: Hot HVAC Piping (to 200 Degrees F)

a. Insulate the following hot HVAC piping systems

1) Hot gas refrigerant piping.

b. Insulate each piping system specified above with the following type and thickness of insulation:

1) Glass Wool: 1-1/2 in. thick for pipe sizes up to and including 1-1/4 in, 2 in. thick for all 1-1/2 in. pipe and larger.
2) Flexible Unicellular: (Refrigerant piping only) 1 in. thick.

C. Insulation on Piping Exposed to Weather: Protect outdoor insulation from weather by installing an outdoor protective finish weather sided and VVC resistant CPVC or aluminum jacketing. Insulation thickness shall be increased by one size versus specified pipe insulation thickness.

D. Ductwork and Equipment Insulation Materials:

1. Glass Wool Manufacturers:

a. Knauf Insulation
b. Or similar as manufactured by CertainTeed, Johns Manville, Manson or Owens Corning

2. Rigid Glass Wool Ductwork Insulation (R-9.1): UL/ULC Classified unfaced, ASJ+, ASJ and FSK; FHC 25/50 per ASTM E 84 for PSK only; meeting ASTM C 612, Type IA and IB; rigid. Verified to be formaldehyde free by UL Environment, Living Building Challenge – Declare Red List Free.
3. Flexible Glass Wool Ductwork Insulation (R-6): UL/ULC Classified; meeting ASTM C 553 Types I, II and III; ASTM C 1136 Type II and ASTM C 1290. UL GREENGUARD Gold Certified; Verified to be formaldehyde free by UL Environment; does not contain polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE; Certified to meet all requirements of EUCEB. Flexible, limited combustible.
4. Jackets for Ductwork Insulation: ASTM C 1136 Type II, with vapor barrier.
5. Ductwork Insulation Accessories: Provide staples, bands, wire, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
6. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Application and Thickness:

1. Application: Ventilation and AC System Ductwork:

a. Insulate the following ductwork:

1) HVAC supply ductwork between HVAC unit discharge and room terminal outlet.
2) Insulate neck and bells of supply diffusers.
3) HVAC return ductwork between room terminal inlet and HVAC unit inlet.
4) HVAC plenums and unit housing not pre-insulated at factory or lined.
5) Exhaust Ductwork between Indoor-mounted fan and exterior wall penetration.
6) ERV Exhaust and Outdoor Air Intake Between ERV and exterior wall penetration.

b. Insulate each ductwork system specified above with the following type and thickness of insulation:

1) Rigid Glass Wool: In machine rooms, fan rooms, and mechanical spaces insulate all supply air, return air and outside air ductwork with 2 in. thick rigid (minimum R-9.1). All exposed ductwork in occupied areas shall be insulated with same thickness and material.
2) Flexible Glass Wool: 2 in Nominal thickness, 1-1/2 in. installed thickness (minimum R-6), application limited to concealed locations which shall include above ceilings, in chases, and shafts.
3) All Exhaust ductwork between indoor-mounted fan and exterior wall penetration and all vehicle bay make-up air ducts & plenums shall be 2 in. rigid (R-9.1).

F. Equipment Insulation Materials:

1. Rigid Glass Wool Equipment Insulation (R-9.1): UL/ULC Classified; unfaced, ASJ+, ASJ and FSK; FHC 25/50 for PSK only; meeting ASTM C 612, Type IA and IB : rigid. Verified by UL Environment to be formaldehyde free, Living Building Challenge – Declare Red List Free.
2. Flexible Glass Wool Equipment Insulation (R-5): UL/ULC Classified; meeting ASTM C 553 Types I, II and III; ASTM C 1136 Type II and ASTM C 1290. UL GREENGUARD Gold Certified; Verified to be formaldehyde free by UL Environment; does not contain polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE; Certified to meet all requirements of EUCEB. Flexible, limited combustible.
3. Flexible Unicellular Equipment Insulation: ASTM C 534, Type as required.
4. TYPE I - TUBULAR.
5. TYPE II - SHEET.
6. Jacketing material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, Laminated Self-Adhesive Water and Weather Seal jacketing or metal jacket at Installer's option, except as otherwise indicated.
7. Equipment Insulation Compounds; Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
8. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

G. Equipment Insulation Application and Thickness:

1. Application: Equipment:

a. Insulate the following equipment:

1) Drip pan under chilled equipment.
2) Duct-mounted inline sound attenuators
3) VAV Box attenuator

b. Insulate each item of equipment specified above with the following type and thickness of insulation:

1) Glass Wool: 2 in. thick for surface temperatures above 35 degrees F and 3 in. thick for surfaces 35 degrees F and lower.
2) Flexible Unicellular: Same thicknesses as for Glass Wool.

2.7 HYDRONIC PIPING AND ACCRSSORIES

A. Pipe and Tubing Materials:

1. Copper tubing: ASTM grade B 88, Type L hard drawn temper copper tubing.
2. CPVC Plastic Pipe: ASTM D 2846, Chlorinated Poly (Vinyl Chloride) (CPVC) pipe.

B. Fittings:

1. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.
2. CPVC Plastic Fittings: ASTM D 2846, Chlorinated Poly Vinyl Chloride (CPVC) socket-type fittings and solvent for solvent cemented joints.
3. Solder Filler Metals: ASTM B 32, 50-50, Tin-Lead, for condenser water, chilled water, and make-up water and drain piping.
4. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony, for heating hot water and low pressure steam piping.
5. Brazing Filler Metals: AWS A5.8.
6. Gasket Material: EPDM Thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

C. Pipe Sleeves and Escutcheons:

1. General: Provide schedule 40 black steel or 18 gage galvanized pipe sleeve large enough to accept pipe along with specified pipe insulation at each point where pipe penetrates a wall or floor. Sleeve shall be large enough to allow for free movement of pipe however minimized to prevent leakage of smoke and fire during a fire emergency. For all piping exposed to view provide a chrome plated escutcheon that will surround insulation where applicable on pipe for a neat finished appearance. Where piping is concealed above ceilings no escutcheons are required

2.8 REFRIGERANT PIPING

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for refrigeration piping where applicable; base pressure rating on refrigerant piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in refrigerant piping systems. Where more than one type of materials and products are indicated, selection is Installer’s option.

B. Material: Provide pipes and pipe fittings in accordance with the following listing:

1. Tube Size 4-1/8” and Smaller: Copper tube; Type ACR, hard-drawn temper; wrought-copper, solder-joint fittings; brazed joints; mechanical press-fit joints (only if approved by connected equipment manufacturer).

C. Soldered Joints: Solder joints using silver-lead solder, ASTM B32, Grade 96 TS.

D. Brazed Joints: Braze joints using American Welding Society (AWS) classification BCUO-4 for brazing filler metal.

E. Piping Specialties: Provide piping specialties complying with Division-23 “Hydronic Piping” in accordance with the following listing:

1. Pipe escutcheons.
2. Drip pans.
3. Sleeves.
4. Sleeve seals

F. Refrigerant Valves and Accessories: Special valves required for refrigerant piping include the following types.

1. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 degrees F (149 degrees C) temperature rating, 500 psi working pressure. Provide shut-off valves at all terminal units and equipment for services.
2. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided piston and stainless steel spring, 250 degrees F (121 degrees C) temperature rating, 500 psi working pressure.
3. Manufacturer: Subject to compliance with requirements, provide globe and check valves of one of the following:

    a. Henry Valve CO.
    b. Parker Hannifin Corp.; Refrigeration & Air Cond. Div.
    c. Sporlan Valve Co.
    d. Or equal

4. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 Hz., UL-listed, ½” conduit adapter, 250 degrees F (121 degrees C) temperature rating, 400 psi working pressure.
5. Manufacturer: Subject to compliance with requirements, provide solenoid valves of one of the following:

    a. Alco Controls Div.; Emerson Electric Co.
    b. Automatic Switch Co.
    c. Sporland Valve CO.
    d. Or equal

6. Refrigerant Strainers: Brass shell and end connections, brazed joints, monel screen, 100 mesh, UL-listed, 350 psi working pressure.
7. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL-listed, 200 degrees F (93 degrees C) temperature rating, 700 psi working pressure.
8. Refrigerant Filter-Driers: Steel shell, ceramic fired desiccant core, solder connections, UL-listed, 700 psi working pressure.
9. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron coverplate with steel cap screws, replaceable filter-drier core, 700 psi working pressure.
10. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.
11. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL-listed.

12. Manufacturer: Subject to compliance with requirements, provide refrigeration accessories of one of the following:

    a. Alco Controls Div.; Emerson Electric CO.
    b. Henry Valve CO.
    c. Parker-Hannifin Corp.; Refrigeration & Air Conditioning Div.
    d. Sporlan Valve Co.
    e. Or equal

2.9 AIR SOURCE HEAT PUMP ROOFTOP UNITS (RTU-1 & 2)

A. Manufacturers

1. Subject to compliance with requirements specified here within provide rooftop units as manufactured by Daikin, Trane, Valent, or approved equal.
2. Any substitution must fit within the equipment footprint shown on the Drawings.

B. SUMMARY

1. The contractor shall furnish and install packaged outdoor air unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
2. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake with 2" aluminum mesh filter assembly, exhaust air blower, energy wheel, hot gas reheat coil, air-source heat pump, phase and brownout protection, motorized dampers, motorized/two position recirculating damper, filter assembly intake air, supply air blower assembly, exhaust/relief blower assembly, filter assembly for exhaust air, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection.
3. Units shall be provided with a one (1) year parts only warranty from unit startup or eighteen (18) months from shipment, whichever comes first.
4. Units shall be provided with a five (5) year compressor parts only warranty.
5. Units shall be provided with a five (5) year energy recovery wheel parts only warranty.

C. SUBMITTAL

1. Product Data: For each type or model include the following:

    a. Complete fan performance curves for both Supply Air and Exhaust Air, with system operating conditions indicated, as tested in an AMCA certified chamber.
    b. All sound power data for SA discharge, RA inlet, EA outlet, and radiated.
    c. Motor ratings, electrical characteristics and motor and fan accessories.
    d. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
    e. Estimated gross weight of each installed unit.
    f. Installation, Operating and Maintenance manual (IOM) for each model.
    g. Microprocessor Controller (DDC) specifications to include available options and operating protocols. Include complete data on all factory-supplied input devices.
    h. Energy wheel performance data for both summer and winter operation at design conditions (temperatures and airflows).
    i. Electrical consumption data and construction specification for electric heater (if applicable), to include heat output, warranty and safety certifications.
    j. Controls device list stating devices factory furnished and installed by unit manufacturer as well as devices factory furnished and shipped loose for field install by ATC.

k. Confirmation of AMCA certified blower, ETL certification per U.L. 1995 (unit must bear ETL sticker), and energy wheel AHRI certification per Standard 1060. Manufacturer to present supporting documentation of these certifications if required/requested.

D. Compliance:

1. Specification Compliance: A detailed spec compliance at the start of the submittal shall be provided. This should specifically list any and all deviance from the spec by including a full copy of this specification with applicable callouts and highlights. Any deviations not called out on the specification compliance will need to be brought into compliance prior to the project completion at the expense of the manufacturer or manufacturer's local representative. Any submittal without a spec compliance will be immediately returned without review.
2. Schedule Compliance: The submittal shall include a master schedule of performance for all the units. All data shown on the schedules (including notes and sound data) for the air handling units shall be incorporated so that the reviewing engineer can quickly review all the data in one location. All schedule performance and notes shown on the plans shall be either confirmed or called out as a deviation. Any submittal without a schedule compliance will be immediately returned without review.

E. UNIT CABINET

1. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
2. Internal assemblies: 22 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.
3. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
4. Materials: Rigid urethane injected foam. Foam board not acceptable.
5. Thickness: 2 inch (50.8 mm)
6. Thermal Resistance R13
7. Thermally broken
8. Meets UL94HF-1 flame requirements.
9. Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
10. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
11. Thickness: 2 inch (50.8 mm)
12. Thermal Resistance R8
13. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
14. Location and application: Divider panels between outdoor air and return air/exhaust air streams.
15. Unit shall have coating that is compliant with ASTM B117 Non-Scribe Rated for a minimum of 2,500 hours. If unit factory paint/coating is not ASTM B117 Non-Scribe Rated for a minimum of 2,500 hours then the manufactures rep shall use a third party coating to meet this requirement.
16. Roof Insulation: 2 inch (50.8 mm) fiberglass located above the 1 inch (25.4 mm) foam panel.
17. Access panels / doors: Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge galvanized G90 steel or painted galvannealed steel.
18. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.
19. Motorized recirculating air damper for all partial recirc units and two position recirculation air damper for all 100% outdoor air units. Recirculation damper shall be factory installed.
20. Unit duct connections shall match those shown on plans. Verify any horizontal supply and return connections.

F. ELECTRICAL

1. Units shall have a single point of power via non fused disconnect.
2. Unit electrical shall be sized for unit heatpump and SCR electric heater simultaneous operation.
3. Control panel / connections: Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. Units shall be equipped with a Unit Disconnect Switch.
4. Unit shall be wired according to NEC and listed per ETL. ETL listing shall cover all components of the ventilator and not be limited to the control panel. All major electrical components shall be UL or ETL listed.
5. Service receptacle: 120 VAC GFCI service outlet shall be factory furnished and installed. Power to GFCI shall be factory furnished from the unit manufacturer. Install shall be performed so that power to the GFCI is sourced upstream of the main Single Point Power disconnect.
6. Vapor Tight Lights: Provide service lights mounted in the unit to be used during times of routine maintenance. The lights must be wired by others on the jobsite, as they will not be wired through the unit control center.
7. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.

G. PACKAGED UNIT CONTROLS

1. Unit shall incorporate a factory furnished DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons. See Mechanical Control Sequences drawing(s) for more details.
2. Dehumidification hot gas reheat control
3. Unit supply fan shall be configured for Variable or Constant Volume Setpoint
4. Unit exhaust fan shall be configured

    a. Modulating Volume Setpoint (100% outdoor air units with recirculation capability.)
    b. OA Damper Tracking (partial recirc units)

5. Outside Air / Return Air damper control shall be configured

    a. Modulating Position Setpoint (100% outdoor air units with recirculation capability)
    b. CO2 Sensor (partial recirc units)

6. Economizer control shall be temperature / enthalpy.
7. Dirty filter sensor shall be factory installed.
8. Operating protocol: The DDC shall be factory-programmed for BACNetIP.
9. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the supply and exhaust air blower assemblies. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
10. Factory furnished airflow monitoring required in the supply, and exhaust airstreams.
11. Factory furnished airflow monitoring required on the outdoor air intake for non 100% OA units.
12. Unit shall be provided with a space thermostat measuring temperature. Thermostat shall have an LCD display and push buttons allowing for setpoint adjustments.
13. Secondary heating source shall be capable of simultaneous operation with the air-source heat pump.

14. Refer to controls drawing(s) of associated Air Source Heat Pump Energy Recovery Units. Provide all controls required to provide a complete operable system meeting all control drawing sequence of operation and point list requirements. All devices shown interior to the unit shall be factory furnished and installed by unit manufacturer unless noted otherwise on drawings. Loose devices shall be furnished by the unit manufacturer and ship loose for field installation by project ATC.

H. FILTRATION

1. MERV 8 pleated filter on the outside air stream.
2. MERV 8 and MERV 14 disposable pleated filters shall be provided in the supply final air stream.
3. MERV 8 filters in the exhaust air stream.
4. 1 full set of spare outside air, supply air, and return air disposable filters shall be provided. There should be a total of 2 full sets of disposable filters provided.

I. FANS AND MOTORS

1. Supply Air blower assemblies: Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.
2. Exhaust Air blower assemblies: Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.
3. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
4. Fan: Direct drive, airfoil plenum fan with aluminum wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.
5. Blades: Welded aluminum blades only.
6. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".
7. Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
8. Exhaust fans must be capable of operating at full economizer airflow at the total return air airflow with the resulting total static pressure.
9. Factory installed motor shaft groundings on all fans.
10. Both the supply and exhaust fan shall be equipped with factory furnished and installed fan airflow monitoring stations.

J. ELECTRIC POST-HEAT SECTION

1. Post-heater shall be SCR control and shall include a temperature sensor with field adjustable set point, located in the outdoor air stream.
2. Heat output of the post-heater shall be infinitely variable
3. Electric post-heater shall be able to simultaneously operate with the air-source heat pump.
4. Electric heater shall be powered by unit high voltage single point power. Unit MCA/MOP shall reflect unit heat pump and SCR electric heater simultaneous operation.

K. REFRIGERATION SYSTEM

1. DX Heat Pump Coil shall be factory installed and meet the design requirements.

    a. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.
    b. Refrigeration systems with more than one circuit shall have interlaced evaporator coils.
    c. Coil casing shall be constructed of 16 gage galvanized steel.
    d. Coil tubes shall be constructed of 1/2" diameter, 0.016" thick seamless copper tubing.
    e. Coil fins shall be constructed of 0.0060" thick aluminum.
    f. Coil to be coated with ElectroFin® coil coating.
    g. Unit heat pump heating performance must meet or exceed scheduled performance at the associated design parameters. Units shall not be submitted based on “nominal tonnage”.
    h. Drain pan shall be constructed of a minimum of 18 gage 201 stainless steel.
    i. Drain pan shall be double-sloped to ensure condensate removal from unit.
    j. Drain pan shall extend a minimum of 8” past the evaporator coil to ensure condensate retention.
    k. P trap: If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.

2. Reheat Coil: Reheat coil with factory installed modulating hot gas reheat valve. Hot gas reheat is required to be done internal to the unit. Piping back to a remote condensing unit is not accepted.

    a. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.
    b. Coil casing shall be constructed of 16 gage galvanized steel.
    c. Coil tubes shall be constructed of 5/16" diameter, 0.012" thick seamless copper tubing.
    d. Coil fins shall be constructed of 0.0060" thick aluminum fins.
    e. All controls devices required to control unit reheat per the controls drawing(s) shall be factory furnished by unit manufacturer. All devices shown interior to the unit shall be factory furnished and installed by unit manufacturer. Loose devices shall be furnished by the unit manufacturer and ship loose for field installation by project ATC.
    f. Coil is to be coated with ElectroFin® coil coating.

3. Condenser System: Unit shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing. The condenser coils are coated with ElectroFin® coil coating. Condenser coils and appurtenant condenser fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the exterior of the unit. Condenser section is to be in a packaged. Refrigeration circuit to in a reversing valve for heat pump operation. Unit shall be capable of operating in heat pump mode down to 10F or below.

    a. Fan blades must be constructed of aluminum or a composite material and have a geometry designed and documented to reduce sound and energy when compared to a traditional rectangular blade fan. Traditional rectangular blade fans are not allowed due to increased noise generated and increase power utilized.
    b. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up.
    c. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal protector.
    d. Lead condenser fan will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point. Motors shall be UL Recognized and CSA Certified.

e. Single condenser fan running at max RPM and design static pressure shall not exceed an A-weighted sound power level of 75 db at free inlet/outlet test conditions.
f. Fans may be full width or partial width. Fans modified to partial width through the use of banding or other blade reduction method are not acceptable.
g. Fans shall be mounted on minimum 1” tall neoprene isolators.
h. Hail Guards: Protects the condensing unit from damage due to extreme weather conditions such as hail and flying debris.

4. Compressors: The refrigerant compressor(s) shall be inverter hermetic scroll-type compressors and shall be equipped expansion valves, EXV(s) or TXV(s).

a. Compressed refrigerant system shall be fully charged with R-410A refrigerant and contain the following items:

1) Suction and discharge service valves.
2) Suction and discharge isolation valves.
3) Reverse rotation protection.
4) Oil level adjustment.
5) Oil filter.
6) Filter drier
7) Short cycling control.
8) High and low pressure limits.
9) Crankcase heaters (where applicable).

b. Compressors shall be installed using manufacturer's recommended rubber vibration isolators.
c. Capacity control shall be provided through the use of a single inverter scroll compressor. Additional compressors, if required, shall be fixed stage scroll compressors. All necessary control devices per the controls drawing(s) shall be factory furnished by unit manufacturer.
d. Compressors shall be provided with a five (5) year parts only warranty. This warranty will begin on the ship date of the unit.

L. OUTDOOR AIR SECTION ENERGY RECOVERY (ERV)

1. Energy Wheel: Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette.
2. Unit energy wheel shall be sized for the full volume of scheduled outdoor and exhaust air without any air bypassing the energy.
3. The energy wheel shall be an integral part of the unit from the manufacturer, mounted perpendicular to the base of the unit. No field assembly, ducting, or wiring shall be required with energy recovery option.
4. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt with a five year parts only warranty.
5. The wheel media shall be a polymer film matrix in a stainless steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable.
6. Silica gel desiccant shall be permanently bonded to the polymer film and is designed and constructed to permit cleaning and servicing.
7. Energy recovery wheel bypass should be provided on all partial recirc units with an energy recovery wheel.
8. Energy wheel to have factory furnished and wired VFD to single point power.
9. Electric preheater shall be provided in addition to a wheel VFD for frost control of the energy wheel. Preheater assembly shall include a thermostat and pressure sensor on the wheel assembly to initiate frost control sequence. Preheater shall comply with UL 1995 and be constructed on a galvanized steel frame.

10. Latent energy shall be transferred entirely in the vapor phase with no condensation.
11. The energy wheel is to have a five (5) year parts only warranty.
12. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.
13. All associated controls devices located interior to the unit shown on the controls diagram shall be factory furnished and installed by unit manufacturer.
14. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.

M. ROOF CURB

1. Curb shall be minimum 24” High discharge with spring isolators; refer to specification 230548 for more info
2. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

N. Motorized Dampers

1. Frame shall be constructed of a 16 gage galvanized steel hat-channel.
2. Blades shall be constructed of 16 gage galvanized steel strengthened by three longitudinal 1 inch deep “vee” grooves.
3. Blades shall be symmetrical relative to its axle pivot point.
4. Axle bearings shall be synthetic sleeve-type and rotate inside extruded holes in the damper frame.
5. Blade seals shall be extruded vinyl permanently bonded to the appropriate blade edges.
6. Frame shall include flexible stainless steel compression-type jamb seals.
7. Modulating spring-return actuators shall be provided by the factory, installed on the damper, and wired to the control center. Each damper shall have a dedicated actuator. Single actuators with gear trains are not acceptable.
8. Damper leakage shall be no more than 3 cfm/sq.ft. at 1 in.wg static pressure.
9. All control devices necessary per unit controls drawing(s) shall be provided by unit manufacturer. All devices interior to the unit shall be factory furnished and installed by unit manufacturer. Loose devices that are to be installed exterior to the unit shall be furnished by the unit manufacturer and ship loose for field installation by project ATC.

O. Outside Air Flow Monitoring: Non 100% outdoor air units shall have a factory furnished and installed outside air flow monitoring station with the following capabilities:

1. Airflow sensor accuracy to be a minimum 3% (4% Max) of reading from 0 to 2,000 fpm.
2. Temperature accuracy to be at minimum +/- 0.15F from -20F to 160F.
3. Analog outputs to be field configured 0-10VDC for communication with BAS.

P. SEQUENCE OF OPERATIONS AND CONTROL POINTS

1. Refer to control drawings

Q. FACTORY VERIFICATION TESTING

1. Unit shall be thoroughly run tested prior to shipment from the factory.
2. Factory run test report shall be provided at the request of the engineer, contractor, or owner.
3. Testing Procedures (the non-applicable devices should be removed from this list)

    a. Unit shall be subjected to and pass a dielectric (hipot) test.
    b. All motorized dampers shall be cycled one full stroke while installed in the unit using the factory-provided motorized actuators.
    c. Supply fan

1) Visually inspect ramp-up, ramp-down, and rotation direction of fan when enabled.
2) Verify fan pressure proving switch operation.
3) Measure and record current draw through supply fan motor(s).

d. Exhaust fan

1) Visually inspect ramp-up, ramp-down, and rotation direction of fan when enabled.
2) Verify fan pressure proving switch operation.
3) Measure and record current draw through exhaust fan motor(s).

e. Energy recovery wheel

1) Visually inspect energy recovery wheel cassette is free to rotate within cassette.
2) Visually inspect energy recovery belt drive mechanism.
3) Enable energy recovery wheel motor and ensure proper rotation.
4) Measure and record current draw through energy recovery wheel motor.

f. Condensing fans

1) Ensure fans rotate freely without obstruction.
2) Energize fans and ensure proper rotation.
3) Measure and record the amount of current draw through each condensing fan.

g. Refrigeration system

1) Measure and record subcooling and superheat on circuit A with hot-gas reheat valve closed (0%) after 15 minutes of steady-state operation.
2) Measure and record subcooling and superheat on circuit A with hot-gas reheat valve open (100%) after 15 minutes of steady-state operation.
3) Measure and record subcooling and superheat on circuit B after 15 minutes of steady-state operation.

4. Test report shall be provided prior to unit startup and available from the factory upon request.

2.10 ROOFTOP MAKE-UP AIR UNIT (MAU-1)

A. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:

a. Greenheck Fan Corporation
b. Aaon
c. Valent
d. Approved equal

B. MANUFACTURED UNITS

1. Rooftop Make-Up Air Units shall be fully assembled at the factory and consist of an insulated metal cabinet louvered outdoor air intake with metal mesh filter assembly, motorized intake damper, filter assemblies for intake air, supply air blower assembly, insulated low leakage, and electrical control unit with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit with the exception of field-installed components shall be assembled and test operated at the factory.

C. CABINET

1. Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
2. Outside casing: 18 gauge G60 galvanized steel. Note: pre-painted polyester on G60 galvanized steel provides highest corrosion resistance. Components that receive a painted finish per A / E specification shall be of 18 gauge type A60 galvanneal steel and shall be painted with a baked industrial enamel finish. Components that receive a painted finish per A / E specification shall be painted with a polyester urethane powder coat, color selection by Architect.
3. Internal assemblies: 18 gauge, galvanized (G90) steel except for motor supports which shall be minimum14 gauge galvanized (G90) steel. Inner wall of double wall construction shall be minimum 24 gauge G90 steel.
4. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
5. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.

    a. Thickness: 1 inch (25 mm)
    b. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
    c. Location and application: Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.

6. Supply Air blower assemblies: Blower assemblies consist of an electric motor and a belt driven blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on 1.125 inch thick neoprene vibration isolators.
7. Control panel / connections: Make-Up Unit shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.
8. Motorized dampers: Motorized dampers of low leakage insulated low leakage type shall be factory installed.
9. Sensors are considered to be part of various optional operational modes or device controllers and are to be factory supplied and installed as specified by the A / E. See IOM / Sensors Installed by Factory

D. BLOWER SECTION

1. Blower section construction, Supply Air and Exhaust Air: Belt drive motor and blower shall be assembled onto a 14 gauge galvanized steel platform and must have neoprene vibration isolation devices.
2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
3. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.

4. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
5. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, “Laboratory Methods of Testing Fans for Rating”.

E. MOTORS

1. General: Blower motors greater than ¾ horsepower shall be “NEMA Premium™” unless otherwise indicated. Minimum compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 00 00, matched with fan load. Motors shall be 60 cycles, 3 phase 460 volt.

F. UNIT CONTROLS:

1. The MAU shall be constructed so that it can function as a stand-alone make-up air system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a make-up air system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
2. MAU shall incorporate a DDC controller with integral LCD screen that provides text readouts of status, operating settings and alarm conditions. DDC controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the MAU are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.
3. Operating protocol: The DDC shall be factory-programmed for LonWorks or BACnet MSTP or BACnet IP, coordinate with ATC Contractor.
4. Variable Frequency Drive (VFD): MAU shall have factory installed variable frequency drives for modulation of the blower motors The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate. MAU shall have factory- installed multi-speed blower motor.

G. FILTER SECTION: MAU shall have MERV 13 disposable pleated filters located in the outdoor air intake and shall be accessible from the exterior of the unit.

2.11 ROOFTOP ENERGY RECOVERY VENTILATOR (ERV-1)

A. MANUFACTURERS

1. Subject to compliance with project plans and specifications the following manufacturers are approved to supply products.
2. Acceptable Manufacturers

   a. Oxygen8
   b. Ventacity
   c. Aldes
   d. Or equal

B. DOAS Units

1. DOAS units shall be factory assembled and tested. Units shall include insulated steel cabinet, total plate heat exchanger, split DX coil, fan and motor assembly, filter rack, and integral controls.

C. CABINET

1. Cabinet shall be nominal 2-inch double wall panel with R13 thermal insulation. Cabinet exterior shall be 18-gauge galvanized steel on base panels and 24-gauge pre-painted steel on wall and roof panels and meets or exceeds 650-hour salt spray test based on ASTM B117. Liners and other steel components shall be galvanized steel. All seams shall be sealed to provide airtight casing.
2. Doors shall be nominal 2-inch double wall panel with the same construction as cabinet. Doors shall be fitted with hinges and door handles. The doors shall have one lockable handle as standard.
3. The unit will be designed for single side access service and maintenance from the front to allow for a compact installation.

D. FILTERS

1. Unit shall include 4-inch filter rack for the outdoor air and return air paths upstream of energy recovery exchanger. Filters shall be accessed through hinged filter access door. Supply one set of MERV 13 pleated filters for the outdoor air stream and one set of MERV8 for the return air stream. All filters must be UL approved.
2. Provide factory mounted pressure sensors to measure filter pressure drop across filters. Pressure drop shall be digital feedback to controller for utilization in control and alarm sequencing. Unit controller shall monitor filter pressure level and report when filter changes are required.

E. FANS

1. Fans shall be mixed flow plenum type with direct drive motor. Fan and motor assembly shall be factory mounted and balanced. The fans will be capable of operating in ambient temperatures of up to 40°C.
2. Fan motors shall be permanent magnet, synchronous motor type with integral digital motor controller. Fan bearings shall be serviceable type with an L-10 life of 40,000 hours. Fan motors will be UL approved.
3. All fans shall be equipped with integral airflow monitoring system connected to the unit controller.
4. Provide means to easily remove fan-motor assembly for service through standard man doors.
5. Fans should be designed such that all service can be performed in the field, including replacement of bearings.
6. Fan motor drives shall be [208/60/3] and be UL approved. Fans will be protected by UL approved motor protection circuit breaker.

F. ENERGY RECOVERY DEVICE

1. Where indicated, units shall include plate type counter flow heat exchanger fabricated with a polymer membrane and aluminum casing. Within the heat exchanger channels, maximum pressure differential shall be 7.2” w.c., and maximum leakage between airstreams shall be 0.5% of nominal airflow.
2. The energy recovery device must have an ISO Hygiene rating of 0.

3. Unit shall include integral bypass dampers with modulating actuators. Unit controller shall operate bypass dampers to maximize heat transfer without frosting and bypass heat exchanger during economizer mode. Energy recovery device shall be installed over a stainless-steel double sloped condensate pan if bypass defrost control sequences are used, or if design conditions require.

G. ELECTRIC POST HEATING COIL

1. Provide open coil electric heaters of the size, capacity and performance shown in the equipment schedules.
2. All duct heaters shall be tested and certified to UL and CSA.
3. Frame to be corrosion-resistant and made of galvanized steel.
4. Coils shall be made of high-grade Nickel-Chrome alloy and shall be insulated from the frame by means of non-rotating ceramic bushings.
5. Heater to come with door mounted disconnect switch and air proving switch
6. SCR control is time proportioning type that modulates the heater and supplies the exact amount of power to match the demand. Input signal will be 0-10V.
7. Heaters shall be equipped with a fail-safe automatic reset disc-type thermal cut-out located in the top frame component above the heating element.
8. Duct heaters shall be non-sensitive to air flow direction for horizontal or vertical ducts without impairing safety.

H. DX HEAT PUMP COIL (Heating and Cooling)

1. Where indicated, unit shall include AHRI 410 tested fin tube type DX coil for use with R-410A. Fins shall be aluminum with a minimum thickness of 0.006”. Tubes shall be minimum 3/8” OD, minimum 0.014” tube wall seamless copper tube mechanically expanded into fins. Coil shall have interlaced circuits to match remote condensing unit when required. Coil casings shall be galvanized steel. Coils shall include external drain and vent connections. Coil shall be mounted in a rack over a stainless-steel double sloped condensate pan. Coil shall be shipped with nitrogen holding charge and tested to 650 psi.
2. When VRV integration is used, the AHU integration controller (EKEQ) must be factory mounted and wired to EKEXV expansion valve kit.
3. Liquid and Gas thermistors are to be mounted to coil and wired to EKEQ kit in the factory.
4. EKEXV expansion valve kit will be mounted, and connections will be brazed to coil. Liquid and Gas lines to be capped at outside of AHU. Coil and EKEXV kit must be tested to 650 psi, and then nitrogen charged for shipment to site.

I. CONTROLS

1. Unit shall include an integrated microprocessor-based unit controller. The controls shall be located in the integral controls cabinet. All unit controls shall operate off a transformer from the main power supply for single point power connection. All internal controls and sensors shall be factory prewired and tested.
2. The control system will regulate temperatures, airflows and other functions as required. Unit controller shall be pre-programmed with factory tested software for all possible functions.
3. The controller shall provide the following, refer to sequence of operation for specific unit control sequences;

    a. Control of fans correcting for both changes in total static pressure and air density in both VAV and constant airflow applications.
    b. Fan performance monitoring.
    c. Ventilation airflow monitoring and control.
    d. Airflow density correction for winter and summer conditions.
    e. Energy recovery optimization including operation of bypass damper.
    f. Supplemental heating and cooling when included.
    g. Frost protection.
    h. Monitoring alarms, faults and maintenance points including filter changeout.

i. Time and date schedules.
j. Data logging and trending.

4. Include wireless capability that will allow the client to access remotely via internal wi-fi network.
5. Controller shall be BACnet IP and BTL certified and include Modbus communication. Communication shall include monitoring, control, alarms, faults and maintenance information.
6. Provide factory installed and tested contactors, overloads, fusing, starters motor speed controllers for supply and exhaust. Include all necessary control transformers.
7. Provide unit mounted non-fused disconnect switch with single point power connection.
8. Supply all necessary temperature and pressure sensors complete with plug in wiring harnesses for proper option of unit.
9. When VRV integration is used, the AHU integration controller (EKEQ) must be factory mounted and wired to EKEXV expansion valve kit.
10. Liquid and Gas thermistors are to be mounted to coil and wired to EKEQ kit in the factory.

J. PLASTIC COMPONENTS

1. All plastic components that are in the airstream, must be of a UL94 rated material.
2. If gasketing is used to join unit sections together, gasketing must be a UL94 approved compound.

2.12 TERMINAL HEATING UNITS (ELECTRIC)

A. Electric Unit Heaters (EUH)

1. Materials and Equipment:

a. General: Except as otherwise indicated, provide manufacturer's standard electric propeller unit heater materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for a complete installation.

2. Heating Elements:

a. General: Except as otherwise indicated, provide manufacturer's standard heating elements of types, sizes, capacities, and ratings for duty indicated; consisting of resistance elements in steel sheath with extended fins, or with spirally finned sheath.
b. Heating Capacity: Size elements for indicated fan speed, CFM, room heating load (BTUH), entering air temperature, and electric inputs (watts, voltage, phase).

3. Casings:

a. General: Provide casings braced and reinforced to provide required stiffness, and with adjustable heating element supports and brackets. Provide rounded corners. Phosphatize and paint casings inside and out with single coat of baked-on enamel; and zinc plate hardware. Include fan orifice (venturi) in casing, as well as threaded hanger connections (weld nuts). Fabricate from 18-gauge galvanized steel.

4. Air Deflectors:

a. General: Provide manufacturer's standard air deflectors of the following types:

1) 4-way finned louvers.
2) Cone diffusers.
3) Vane outlets.

4) Louver outlets.

5. Motors:

a. General: Provide totally enclosed shaded-pole, or permanent-split capacitor motors, Class "B" insulation, resiliently mounted, tap wound with built-in thermal overload protection, and with sleeve type or permanently lubricated ball bearings.
b. Internal Electrical Wiring: Provide units with high temperature, heat-resistant electrical wiring enclosed in flexible metal conduit extending from terminal junction box to electrical devices. Provide fusing for motor and control circuit wiring.
c. Devices: Provide propeller unit heaters with the following devices:

1) Thermally activated fan switch to keep fan motor operating until residual heat is dissipated.
2) Disconnect switch.
3) Automatic reset, high limit cut-out switch located in discharge air stream.
4) Magnetic contractor.
5) Transformer.

6. Fans:

a. General: Provide aluminum propeller fans which are balanced statically and dynamically, of indicated capacity. Provide fans suitable for standard or sparkproof application.

7. Manufacturers: Subject to compliance with requirements, provide propeller unit heaters of one if the following:

a. OUELLET
b. Markel
c. Qmark
d. Berko
e. Or Equal.

B. Electric Radiant Panels (ERP)

1. HEATING ASSEMBLY: The heating assembly shall be UL Listed and CSA Certified and shall consist of powdered graphite encapsulated in a plastic laminate with heavy duty copper buss bars running the entire length, backed by 1 inch, 1 pound density high temperature fiberglass insulation to insulate against heat loss to the ceiling and separated from the inside of the panel by a dielectric insulation to assure uniform heat transfer throughout the entire radiating surface of the heater. The rated input shall be: (62.5 watts/sq. ft. with an average temperature of not more than 165 degree F.) or (95 watts/sq. ft. with an average surface temperature of 200 degree F.), to assure long trouble free life.
2. The panel voltage shall be 208.
3. WIRING: For connection to the main power supply, the heater shall be completely prewired, with the lead wires housed in a 48 inch length of flexible metal conduit and connector for J-Box mounting. Appropriate wiring diagrams shall appear on the back of the panel.
4. PANEL ASSEMBLY: Welded steel construction and advanced powder coat finishes provide for long-lasting durability for both commercial and residential applications.
5. Manufacturers: Subject to compliance with requirements, provide electric radiant heating panels of one if the following:

a. OUELLET
b. Markel
c. Qmark
d. Berko

e. Or Equal.

C. Electric –Infrared Heaters (EIH)

1. Materials and Equipment:

a. General: Except as otherwise indicated, provide manufacturer's standard electric propeller unit heater materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for a complete installation.
b. Heating Elements:

1) General: Except as otherwise indicated, provide manufacturer's standard heating elements of types, sizes, capacities, and ratings for duty indicated; consisting of a stainless steel element (with 60* radiation angle.
2) Heating Capacity: Size elements for scheduled room heating load (BTUH), entering air temperature, and electric inputs (watts, voltage, phase).
3) Wire guard for heated section shall be included.

c. Casings:

1) General: Provide 24-Gauge anodized aluminum construction with no visible light emitted. Color to be selected by Architect.

d. Air Deflectors:

1) General: Provide manufacturer's built-in adjustable directional system.

e. Installation:

1) Horizontal mounting as shown
2) Surface mounted to connection box on non -combustible surface
3) Must be connected only to a circuit protected by suitable ground fault protection
4) Recommended installation height 8 to 10 feet.

f. Warranty: 1 year warranty against factory defects.
g. Manufacturers: Subject to compliance with requirements, provide electric unit heaters of one if the following:

1) Ouellet
2) Markel
3) Berko
4) Qmark
5) Or Equal.

2.13 ELECTRIC DUCT COIL

A. General

1. Duct heaters shall be open coil heaters.

a. Voltage, size, wattage, control type and control voltage shall be as scheduled on the drawings.
b. Manufacturer shall be capable of furnishing three-phase heaters. Refer to mechanical schedules.
c. Heaters shall be UL listed for zero clearance and meet all applicable requirements of the NEC.

d. Electric duct heaters shall be independently powered.

2. Type: Heaters shall be of the slip-in mount type for duct mounting.
3. Duct heaters shall be for indoor use only.
4. Heating Elements: Open coil of resistance wire, 60 percent nickel, 20 percent chromium, and 20 percent iron supported and insulated by floating ceramic bushings. Heating element support structure shall consist of galvanized steel wire formed and constructed to support ceramic bushings through which the heating element passes.
5. All heating elements shall be made of nickel/chromium resistance wire with ends terminated by means of staking and heliarc welding to machine screws.
6. Coil Layout: Vertical (air flow horizontal)
7. Casing Assembly: Slip-in type, galvanized-steel frame
8. Coil terminals shall be nickel plated, terminal insulators and bracket bushings shall be of ceramic and securely positioned.
9. Control Box: Control cabinet shall have a solid cover also of heavy gauge galvanized steel and held in place with hinges and interlocking disconnect switch.
10. Orientation: Heaters shall be interchangeable for mounting in a horizontal or vertical duct.
11. Heaters up to 60 kW shall be capable of being rotated 180 degrees.
12. Built-in components shall include disconnecting break magnetic contactors, transformer with primary fusing, pressure-type airflow switch set at 0.05" + 0.02" WC all as required by UL, branch circuit fuses per NEC, interlocking disconnect switch and a single terminal block to accept the number, type and size of conductors as required.
13. Over-Temperature Protection:

    a. Serviceable through electric duct heater without removing heater from duct or unit.
    b. Disk-type, automatic reset, thermal-cutout safety devices for primary over-temperature protection.
    c. Secondary over-temperature protection by built in disc type manually resettable thermal cutouts. These devices must function independently of one another and are not acceptable if series connected in the control circuit wiring.
    d. All duct heaters will require either a fan interlock circuit or an airflow switch. The airflow switch shall be diaphragm operated differential pressure switch to prevent duct heater from operating when there is no air flow.

14. A disconnecting magnetic control circuit is required.
15. Over-current protection by means of factory-installed fusing within the control cabinet shall be provided. Heating elements shall be subdivided and fused accordingly.
16. All wiring, component sizing, component spacing and protective devices within the control cabinet shall be factory installed and comply with NEC and UL standards.
17. Control Panel: Mounted on unit, with means of a safety disconnect and overcurrent protection. Include the following controls:

    a. Magnetic contactor.
    b. Single-stage Silicon Controlled Rectifier (SCR) that shall be capable of accepting 0-10Vdc or 4-20mA as control signal.
    c. 24V control voltage

18. A wiring diagram depicting layout and connections of electrical components within the control cabinet shall be affixed to the inside of the control cabinet cover.
19. A rating plate label shall be affixed to the exterior of the control cabinet cover which states model number, serial number, volts, amps, phase, frequency, control volts, volt-amps and minimum airflow requirements.

B. Manufacturer

1. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include:

a. Neptronic
b. Indeeco
c. Greenheck
d. Or approved equal

2.14 DX HEATING/COOLING COIL

A. Design Pressures and Temperatures

1. Coils shall be designed to withstand 250 psi maximum operating pressures and a maximum temperature of 300°F for standard duty copper tube coils with standard headers. Higher limits are available, depending on coil construction and / or materials used.

B. Factory Testing Requirements

1. Coils are to be pressurized and then completely submerged in warm water containing special wetting and final cleaning agents for leak testing and tested with a minimum of 315 psi air pressure for standard copper tube coils. A hydrostatic leak test is available upon request. Certified hydrostatic leak test and Certificate of Conformance also available upon request. Coils must display a tag with the inspector's identification as proof of testing. After testing coils are to receive a 5 lb. Nitrogen charge assuring the coil as received remains leak free and clear of internal contamination.

C. Fins

1. Coils shall be of plate fin type construction providing uniform support for all coil tubes. Coils are to be manufactured with die-formed aluminum, copper, cupro-nickel, stainless steel or carbon steel fins with self-spacing collars, which completely cover the entire tube surface.
2. Fin corrugations available shall include: Flat, Rippled and “Hi-F” Sine Wave for coils built with .625” OD tubes and utilizing a 1.5” equilateral tube pattern; Flat, Rippled and “Hi-F” Sine Wave for coils built with .50” OD tubes and utilizing a 1.25” equilateral tube pattern; “Hi-F” Sine Wave for coils built with .50” OD tubes and utilizing a 1.5” equilateral tube pattern; Rippled and “Hi-F” Sine Wave for coils built with .375” OD tubing and utilizing a 1.0” equilateral tube pattern; “Hi-F” Sine Wave for coils built with .375” OD tubes and utilizing a 1.25” equilateral tube pattern.
3. Standard fin thickness’ available shall include: .0060” +/- 5% for aluminum and copper; .0075” +/- 5% for aluminum, copper, and cupro-nickel, carbon steel and stainless steel; .0095” +/- 5% for aluminum, copper, carbon steel and stainless steel; .016” +/- 5% for aluminum and copper.
4. Fins are to be formed with full collar on all of available materials, corrugation styles, tube diameters and tube patterns.
5. Fin spacing available shall include: 4-14 fins / inch on coils supplied with .625” OD tubing; 6-14 fins / inch on coils supplied with .50” OD tubing; 4-20 fins / inch on coils supplied with .375” OD tubing.

D. Tubing

1. Tubing and return bends shall be fabricated from UNS 12200 seamless copper conforming to ASTM B75 for standard pressure and temperature applications. Elevated duty and special application construction tube cores shall be available in seamless 90/10 Cupro-Nickel Alloy #706, Stainless Steel ASTM #A249 grade 304L or 316L and Carbon Steel ASTM #A214 welded or #A179 Seamless.
2. Core tubes (excluding hot dipped galvanized steel coils) shall be mechanically expanded to form an interference fit within the fin collars. Expansion shall not decrease the tube wall thickness.
3. Coils shall be manufactured using return bends of the same material as the core tubing. Return bend wall thickness, at the outside circumference of the bend, shall be no less than the core tube wall thickness. The use of “hairpin” style tubes & return bends shall be unacceptable.

   Available tube size and wall thicknesses shall be as follows:

Material	0.375” O.D.	0.50” O.D.	0.625” O.D.	1.0” O.D.
Copper	0.013, 0.016, 0.020, 0.025, 0.030	0.016, 0.022, 0.030	0.020, 0.025, 0.035, 0.049	0.023, 0.035, 0.049
Cupro-Nickel			0.020, 0.035, 0.049	0.035, 0.049
Carbon Steel			0.035, 0.049, 0.065	0.035, 0.049
Stainless Steel			0.035, 0.049, 0.065	0.035, 0.049
Admiralty Brass			0.049	

4. Coils shall be made available with copper tubes utilizing internally enhanced Rifled Surfacing when required. As a quality control measure, Coil Manufacturer shall be capable of providing copper rifled tubing, enhanced within it’s own facility, and not supplied by an outside source.
5. As a further quality control measure, Coil Manufacturer shall be capable of supplying all of above listed extruded seamless copper tube sizes and wall thickness’ from their own, in house, Copper Tube Mill. Tube Mill shall be owned by the Coil Manufacturer and operated by trained personnel under the employ and supervision of said Coil Manufacturer.

E. Headers

1. Headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and B251 with an H55 temper for standard applications. Other option for headers for high-pressure construction shall incorporate seamless 90/10 Cupro-Nickel Alloy #706 conforming to ASTM B111, Carbon Steel conforming to ASTM A53A or A135A, Stainless Steel conforming to ASTM A249, at Sch. 10 or Sch. 40, per the application requirements.
2. Headers shall be manufactured using a Pierce and Flare die-punch method when possible. This shall insure that the tube-to-header tube hole intrusions into the header are such that the landed surface area contact length for joint brazing approximates three times the core tube wall thickness.
   Standard construction shall be such that the core tubes will penetrate directly into the header without the use of intermediate adapter tube spuds, except where curving or splaying of headers is required. Each of these core tubes shall extend evenly within the inside diameter of the header to a depth no greater than 0.12 inch. In addition, and without exception, each of these core tubes penetrating the hot gas header(s) shall pass through an oversized hole in the sheet metal casing, of no less than 25% larger than the outside diameter of the core tube. This will prevent metal to metal contact between the tube and the sheet metal casing, allowing the header and core tubes to “float” and eliminating the possibility of premature failure caused by excess vibration from the compressor side (hot gas) of the coil.
3. End caps shall be precision die-formed and positioned inside the header so that the thickness of the brazed fillet joint approximates three times that of the header wall thickness. Manufacturers using standard copper tube end caps, which are brazed over the outside of the end of the headers shall be considered as unacceptable.

F. Connections

1. Standard construction of copper tube condenser coils shall allow for copper sweat connections for type L or K wall copper. Other materials shall be made available dependent upon the materials of construction of the tube core.

G. Brazing & Welding

1. Oxyfuel gas brazing, using fillet rod material of minimum 5% silver shall be used for all non-ferrous tube joints to headers and connections. Ferrous to non-ferrous joints shall contain as much as 35% silver or may be Tobin bronze.
2. Gas shielded arc welding shall be used for all stainless steel joints and also for nay ferrous tube joints made to compatible or alike material headers and connections.

H. Casing

1. Coil casing and endplate shall be fabricated from Galvanized steel, as a standard construction, meeting ASTM and UL G90U requirements, Aluminum, 0.080” thick, optional, Copper, 0.063 “ thick, optional,16- or 14-gauge carbon steel or stainless steel, optional. double-flange casing shall be provided when coils are specified as vertical stacking.

Standard coil intermediate tube sheets (center tube supports) shall be fabricated from the same gauge sheet stock and material as the end plates, and to the following schedule:

Finned Length (inches)	Number of Tube Sheets
6.00 – 48.00	0
48.01 – 96.00	1
96.01 – 144.00	2
144.01 and greater	4

I. Certifications

1. Coil manufacturer shall be certified and registered with the Air Conditioning and Refrigeration Institute (ARI) and shall be an active and current member of the ARI Standard 410 Air-Cooling and Air-Heating Coils certification program and shall have original coil line certifications and computerized selections dating back a minimum of 30 years, as proof of overall company performance, stability and longevity.

J. Agency Approval

1. Coil manufacturer shall be registered by UL to ISO 9000 (ANSI/ASQC Q92). Applicable commercial coil models shall be UL Standard 207 and registered as Refrigerant Containing Components and Accessories; non- electrical. CRN (Canadian Registration Numbers) shall be provided for all coils shipping into Canada as requested.
2. Coil manufacturer shall also possess ASME Section VIII Division 1, U and UM stamping certification as proof of acceptable quality control methods. Manufacturers unable to meet the above listed agency approvals shall be considered as unacceptable.

K. Lead Time and Shipping

1. Standard lead-time for custom made retrofit condenser coils of standard construction with OEM circuiting shall be 11- 15 working days, with reduced lead-time emergency shipment options of 10 working days and 5 working days from order placement date and based upon production approval.
2. Standard lead-time for custom made condenser coils of manufacturer’s own standard design and circuiting shall be 10 working days, with reduced lead-time emergency shipment options for 5 working days, 48-hours and 24-hours from order placement date.

3. All coils shall be quoted and offered as FOB Factory, Full Freight Allowed to any and all destinations within the Continental United States.

L. Manufacturer: Subject to compliance with requirements, provide DX Coil of one of the following:

1. Luvata
2. Daikin applied
3. Fogg Coil
4. Or equal

2.15 DUCTLESS COOLING UNITS

A. GENERAL

1. This section includes the design, performance, refrigerant details, controls and installation requirements for Daikin VRV systems (variable refrigerant volume) distributed by DXS (978-977-9911)
2. All units shall be listed and rated by ANSI/AHRI Standard 1230-2010 and meet all minimum IEER performance requirements as scheduled
3. The units shall be ANSI/UL STD 1995 listed and listed by Electrical Laboratories (ETL) and bear the cETL label.
4. All wiring shall be in accordance with the National Electric Code (NEC).
5. 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.
6. Submittals for Daikin products not provided by DXS will not be considered.

B. SYSTEM DESCRIPTION

1. The variable capacity air conditioning system shall be a Daikin Inverter Driven split system as specified. The system shall consist of an indoor evaporator exclusively matched to an outdoor variable speed rotary compressor condensing unit.
2. The outdoor unit shall be configured for horizontal discharge airflow and complete with a variable speed condenser fan using a single phase power supply.
3. Typical cooling mode operating range shall be between 0°F DB and 122°F DB.
4. Typical heating mode operating range shall be between -4°F WB and 60°F WB.
5. This system shall be designed to operate with a maximum refrigerant pipe length of 164 feet with 98 feet maximum vertical difference (or 230 ft with 164 feet maximum vertical difference for units 2.5 tons and above), and without any oil traps or additional equipment. Refrigerant shall be R-410A.

C. REFRIGERANT PIPING

1. Refer and comply to the refrigerant piping specifications, including the special considerations for VRF refrigerant piping section.

D. FAN COIL UNITS

1. WALL MOUNTED UNIT

a. Daikin indoor unit FXAQ shall be a wall mounted fan coil unit for installation onto a wall within a conditioned space. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment.
b. The indoor unit’s sound pressure shall range from 31 dB(A) to 41 dB(A) at low speed measured at 3.3 feet below and 3.3 feet away from the unit.

c. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing.
d. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
e. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
f. The fan type shall be direct-drive cross-flow with statically and dynamically balanced impeller with high and low fan speeds available.
g. Units shall be provided with a loose field installed condensate pump.

2. ROUNDFLOW CEILING CASSETTE UNIT

a. Daikin indoor unit model FXFQ_T shall be a round flow ceiling cassette fan coil unit with a variable speed direct drive DC type fan for installation into the ceiling cavity, equipped with an air panel grill. It shall be a round flow 360° air distribution type with a fresh white, impact resistant decoration panel.
b. The supply air is distributed via four individually controlled motorized louvers. The louvers can be manually and individually adjusted for multiple configurations, without requiring blank off plates.
c. The indoor unit shall be equipped with built-in occupancy sensor and surface temperature sensor to optimize occupant comfort.
d. The indoor unit's sound pressure shall range from 27 dB(A) to 34 dB(A) at low speed measured at 5 feet below the unit.
e. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.
f. The indoor units shall be equipped with a condensate pan with antibacterial treatment and factory-mounted condensate pump. The pump shall provide up to 33-1/2" of lift from bottom of unit to top of the drain piping with built-in safety shutoff and alarm.
g. The fan shall have a variable speed direct drive DC motor with a statically and dynamically balanced impeller with 3 user-selectable fan speeds. The automatic fan speed mode shall allow the fan to vary between 5 speeds based on space load.
h. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the high efficiency air filter options.

E. CONTROLS

1. Fan coil units shall be supplied with Individual Zone Controllers, similar to Daikin model BRC1E73

a. Remote controllers shall be hard wired by installing contractor.
b. Controllers shall be able to function as follows:

1) The controller shall have dual or single Cool and Heat setpoints for occupied periods, and independent setback setpoints for unoccupied periods.
2) The controller shall the ability to digitally prohibit individual buttons and functions.
3) The controller shall have a self diagnosis function that constantly monitors the system for malfunctions (total of 80 components).
4) An LCD digital display will allow the temperature to be set in 1°F units.
5) The controller shall be equipped with a thermostat sensor.
6) The controller shall have the ability to automatically changeover the mode of operation with dual or single setpoints.
7) Controller shall have built-in 7 day, weekday plus Saturday Sunday (5+1+1), weekday plus weekend (5+2) and everyday (1) scheduler.
8) Controller shall have a simple display mode, displaying only the operation mode, the setpoint(s), and the room temperature.

F. CONDENSING UNIT

1. The outdoor 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.
2. The fan shall be a direct drive, propeller type fan. The motor shall be inverter driven with permanently lubricated bearings
3. A fan guard shall be provided on the outdoor unit to prevent contact with fan operation.
4. The outdoor coil shall have nonferrous construction with a corrugated fin tube.
5. The compressor shall be a Daikin rotary swing inverter-driven compressor. Compressor safeties shall include internal thermal overload protection. Refrigeration specialties shall include an accumulator, refrigerant metering device and a four-way reversing valve.

G. ELECTRICAL

1. The condensing unit and the indoor units shall have independent 208/230 volts, 1 phase, 60 hertz power.
2. The control voltage between the indoor and outdoor unit shall be 16VDC non-shielded 2 conductor cable.

H. START-UP AND WARRANTY

1. The system must be installed by an authorized contractor/dealer.
2. The manufacturer shall provide off-site assistance, if required, from a factory trained service technician to installing contractor during start-up for each unit. Untrained contractors who wish to bid this project may contact DXS (978-977-9911) to arrange training prior to bid day. Manufacturer shall provide instruction to the owners' personnel on proper unit operation and maintenance.
3. The warranty period shall commence on the date of initial start-up and shall continue for a period of ten (10) years not to exceed eighteen (18) months from date of shipment.

I. Manufacturer: Subject to compliance with requirements provide DCU AC Units of one of the following:

1. Daikin
2. Mitsubishi Electric, Co.
3. Lennox
4. LG
5. Or Equal

2.16 POWER AND GRAVITY VENTILATORS

A. General: Except as otherwise indicated, provide standard prefabricated power and gravity ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.

B. Refer to Division-23 automatic temperature control and control drawings for control sequence.

C. Roof Fans (EF)

1. Type: Centrifugal fan, direct or belt driven as scheduled. Provide aluminum, or galvanized steel, weatherproof housings as scheduled. Provide square base to suit roof curb. Provide permanent split-capacitor type motor for direct driven fans; capacitor-start, induction-run type motor for belt driven fans.
2. Electrical: Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.
3. Bird Screens: Provide removable bird screens, ½ in. mesh, 16-ga. aluminum or brass wire.
4. Motor Operated Dampers: Provide louvered dampers with linkage below curb base (maximum of 6 in.). Provide hinged curb access with restraint cable for service.

5. Finish: Provide two coat 70 percent Kynar/Hylar finish in color selected by Architect. Dry film thickness shall be 1.23 mil. Provide 10 year finish warranty. Submit color selection chart to Architect as part of submittal package.
6. Manufacturer: Subject to compliance with requirements, provide centrifugal roof ventilators of one of the following:

    a. Greenheck Fan Corp.
    b. Cook Co., Loren.
    c. Penn Ventilator Co., Inc.
    d. Power Line Fans; Div. of Torin Corp.
    e. Twin City
    f. Or equal

D. Centrifugal In-Line Fans (EF)

1. General: Fans shall be of the centrifugal belt or direct driven in-line type. Units shall bear AMCA label.
2. Fan Housing: Shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Unit shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
3. Fan Wheel: Shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
4. Motors: Shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase, and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.
5. Shafts and Drives: Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing. A NEMA 1 disconnect switch shall be provided, factory wired.
6. Manufacturer: Subject to compliance with requirements, provide centrifugal in-line fans of one of the following:

    a. Greenheck Fan Corp.
    b. Twin City
    c. Cook Co., Loren.
    d. Or equal

E. Roof Hoods (RH):

1. Type: Stationary, natural draft type. Provide weatherproof housings to match power ventilators in materials and finish. Provide square or rectangular base to suit roof curb.
2. Bird Screens: Provide removable bird screens, 1/2" mesh, 16-gal aluminum or brass wire.
3. Gravity Operated Dampers: Provide gravity actuated louvered dampers in curb bases on relief hoods.
4. Manufacturer: Subject to compliance with requirements, provide gravity ventilators of the following:

    a. Greenheck Fan Corp.
    b. Twin City
    c. Cook Co., Loren.
    d. Or equal

F. Prefabricated Roof Curbs:

1. Manufacturer of ventilating unit shall provide his standard roof curb compatible with unit being provided. Curb shall be insulated and sloped to allow for level installation of device. Provide all necessary nailers, cants, etc. for a complete installation.

2.17 METAL DUCTWORK

A. Reference Standards: Material, construction and installation shall meet requirements of most recent editions of the following standards and references, except for more stringent requirements specified or shown on Drawings:

Standard	As Applicable To:
SMACNA HVAC Duct Construction Standards Metal and Flexible	Sheet Metal Ductwork; Duct Liners; Adhesives; Fasteners; Flexible Ductwork.
SMACNA HVAC Air Duct Leakage Test Manual	Duct Leakage Testing
SMACNA Fibrous Glass Duct Construction Standards	Fibrous Glass Ductwork; Tapes
SMACNA Thermaoplastic Duct (PVC) Construction Manual	PVC Ductwork
ADC and TIMA Flexible Duc Performance Standards	Flexible Ductwork
NFPA 96	Kitchen Hood Exhaust Ductwork
NFPA 45	Laboratories using chemicals
SMACNA Guidelines for Welding Sheet Metal	Welded Galvanized, Black Iron and Stainless Steel Ductwork

B. General

1. Provide supporting and hanging devices necessary to attach entire HVAC system including ductwork and equipment, and to prevent vibration.
2. Provide vertical and horizontal supports as required by codes to meet minimum applicable earthquake resistance standards.
3. Ductwork shall be free from vibration under all conditions of operation. Dimensions shown on Drawings for lined ductwork are net inside dimensions. Increase ductwork to accommodate lining requirements.
4. Pipe or conduit crossing duct:

    a. No pipe, conduit, hanger, Architectural element nor structural member shall pass through duct without Designer’s written approval.
    b. Where it is impossible to reroute pipe or conduit and when written approval has been obtained, increase duct size to maintain constant cross sectional area at point of interference. Provide streamlined enclosure for pipe or conduit, as illustrated in SMACNA.

5. When making offsets and transformations necessary to accommodate structural conditions, preserve full cross sectional area of ductwork shown on Drawings.
6. Ductwork shall have pressure velocity classifications as follow:

DUCT CONSTRUCT-ION CLASS	STATIC PRESSURE RATING	PRESSURE	SMACNA SEAL CLASS	SMACNA LEAKAGE CLASS	VELOCITY
4"	4"	Pos.*	A	3	4000 fpm or less
3"	3"	Pos. or Neg.	A	3	4000 fpm or less

2"	2"	Pos. or Neg.	A	6	2500 fpm or less
1"	1"	Pos. or Neg.	A	6	2500 fpm or less
½"	½"	Pos. or Neg.	A	6	2000 fpm or less

*for negative pressures over 3" w.g., refer to SMACNA Round and Rectangular Industrial Duct Construction Standards for joint and intermediate reinforcement requirements.

a. Unless otherwise specified or shown on the drawings, the following pressure classifications shall be used for the types of ductwork listed below:

1) 4" Class: All supply ductwork from discharge of air units to inlets of supply diffusers and/or variable air volume units.
2) 3" Class: All exhaust and system return ductwork. Supply ductwork after the variable air volume units.
3) 2" Class: All other ductwork.

7. Sealing Requirements for Class A, Leakage Class 3 & 6 Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel Ductwork:

a. Transverse Joints

1) During assembly seal all flanged transverse joints with sealing tape of quality equal to Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures. After sealant has cured, seal entire joint with Hardcast Inc. RTA-50 adhesive on to Hardcast Inc. DT tape or approved equal.
2) Seal all non-flanged transverse joints with Hardcast Inc. RTA-50 adhesive on to Hardcast Inc. DT tape or approved equal.

b. Longitudinal Seams

1) Seal all longitudinal seams during ductwork fabrication with Hardcast Inc. Cold Seal 1001 or approved equal.

c. Joints and Ductwall Penetrations

1) Seal all duct joints at takeoffs, access doors, damper bearing penetrations, flexible duct connections etc., with Hardcast Inc. Versa Grip 102 or approved equal.
2) Note, access doors and damper rod penetrations shall be equipped with proper hardware for sealing.

8. Support

a. Space hangers as required by SMACNA (8 ft max) for horizontal duct on 8 ft. centers, unless concentrated loadings require closer spacing.
b. Support vertical duct on each floor or slab it penetrates.
c. Supports for ductwork and equipment shall be galvanized unless specified otherwise.

9. Connections

   a. Connect inlets and outlets of air handling units and fans to ductwork with flexible connections unless fan has vibration isolator mounts inside unit with flexible connections and no external vibration isolators. Exception: Do not use flex on life safety smoke exhaust fans.
   b. Indoors, flexible connections shall be neoprene coated fibrous glass fire retardant fabric, by Ventfabrics, or Durodyne. Outdoors, flexible connections shall be Dupont hypalon coated fibrous glass fire, weather, and UV resistant by Ventfabrics or Durodyne.
   c. Secure flexible connections tightly to air handlers with metal bands. Bands shall be same material as duct construction.
   d. Connections from trunk to branch ducts shall be as detailed on Drawings.

10. Construction

   a. No sharp metal edges shall extend into air streams.
   b. Install drive slips on air leaving side of duct with sheet metal screws on 6" centers.
   c. Spin in collars shall NOT be used for branch connections in 3" or higher pressure class ductwork.

11. Joints

   a. Longitudinal lock seams shall be double locked and flattened to make tight joints.
   b. Make transverse joints, field connections, collar attachments and flexible connections to ducts and equipment with sheet metal screws or bolts and nuts. Do not use rivets and staples.

12. Prefabricated Transverse Duct Joints

   a. Transverse joints in galvanized sheet metal ductwork may be made with galvanized gasketed frame and angle duct joint system by Ductmate, TDF, TDC or approved equal. Angles shall be at least 20 gauge. Prefabricated transverse duct joints shall not be used for duct 16 GA. and heavier, nor for duct 23 GA. or lighter.
   b. Secure angles to duct with screws (using clutched arbor) or spot welds spaced as recommended by manufacturer for duct pressure class.

13. Elbows and Bends

   a. Elbows and bends for rectangular ducts shall have centerline radius of 1 1/2 times duct width wherever possible. Elbows for grease exhaust and fume hood exhaust shall be full radius. Vanes or mitered duct are not allowed.
   b. Where centerline radius is less than 1 1/2 times duct width (on supply, return and exhaust ductwork), elbows shall be radius throat (square throat allowed when turning around column or other close objects) with radius heel. For elbows whose width is greater than 48 inches and/or where shown on plans, provide splitter vanes. Install vanes in accordance with SMACNA. Where multiple elbows are separated by less than ten duct diameters use splitter (full length) vanes.
   c. For round ductwork provide stamped elbows, with centerline radii equal to 1 1/2 times duct diameter, or gored elbows as follows:

Elbow Angle	No. of Gores
0° - 36°	2
37° - 72°	3
73° - 90°	5

   d. Elbows for flat oval ducts shall have centerline radii equal to 1 1/2 times duct diameter in plane of bend, or gored elbows with gores as specified for round ducts.

14. Access Panels/Doors

    a. Provide proper pressure and leakage rated, gasketed, duct mounted access panels/doors for the following items with minimum sizes, as indicated. Access doors shall be of double wall construction doors in insulated ducts shall be insulated. Gauges of door materials, no. of hinges, no. and type of door locks shall be as required by the SMACNA Duct Construction Standards. Hinged doors are not acceptable, screwed or bolted access panels are not acceptable. Doors shall be chained to frame with a minimum length of 6" to prevent loss of door. For seal Class A, access doors shall be leakage rated, neoprene gasketed UL 94 HF1 listed, DUCTMATE "sandwich" or approved equal. Door metal shall be the same as the attached duct material. For grease and high temperature ducts, door assembly shall be rated for 2300°F. The minimum sizes are:

        1) Fire dampers 12" x 12", or larger.
        2) Combination Fire/Smoke dampers 12" x 12", or larger.
        3) Smoke dampers 6" x 6" minimum.
        4) Automatic control dampers 6" x 6" minimum.
        5) Manual volume dampers 2 sq. ft. and larger 6" x 6" minimum.
        6) Inlet side to all coils 12" x 12", or larger.
        7) Suction and discharge sides of inline fans 24" x 24" minimum.
        8) At additional locations indicated on drawings, or specified elsewhere 12" x 12" minimum.

    b. Generally access doors are not shown on the drawings, but shall be provided in accordance with the above.

15. Extractors shall have adjusting rod and locknut on outside of duct.
16. Connections to roof fans:

    a. Shall be at least 22 ga. galvanized steel soldered watertight.
    b. Solder side seams at least 12" up from bottom.
    c. Provide suitable dielectric gaskets to join dissimilar materials.

17. Plenums and connections to louvers:

    a. Shall be 18 ga. minimum cross broken and properly reinforced with galvanized angle irons to SMACNA requirements.
    b. Shall have bottom and corner seams soldered watertight at least 12" up from bottom.
    c. Shall have neoprene gaskets or other non corrosible material to make connections to louvers watertight.
    d. Shall pitch connection back towards the louver. Provide half coupling drain connection at bottom of plenum unless noted otherwise. Pipe drain to nearest floor drain.
    e. Shall have unused portions of louvers blocked-off with sheet metal; sealed air and water tight; insulated with 2" thick 6 lb. density rigid or board insulation.

18. Duct Pressure Tests

    a. Pressure test all duct classes after takeoffs and wall penetrations are in place and before applying exterior insulation. Correct any leaks.
    b. Pressure and leak test 100% of all duct work with a pressure class of 3” or higher as specified in paragraph 2.20.B.6.a. Duct shall be constructed so there is no joint or structural failure at the test pressure.

19. Duct Leakage Tests

    a. Leak testing method shall be performed as outlined in the SMACNA HVAC Air Duct Leakage Test Manual. As specified in paragraph 2.20.B.6 & a, utilize Sealing Requirements for Class A and Leakage Class 6 for all ductwork. Provide orifice assembly including straightening vanes, orifice plate mounted in straight tube with properly located pressure taps, and U tube manometer or other device as specified by SMACNA. Orifice assembly shall be calibrated accurately and shall come with calibration curve. Leakage classes shall be as previously specified. Submit leak test report (per SMACNA format) for Designer review. Drawings of ductwork tested shall also be submitted with report, indicating presence of takeoffs, wall penetrations, joints, etc.

20. Materials

    a. Sheet metal ducts shall be constructed of hot dipped galvanized sheet metal with G90 Commercial coating according to ASTM 527 unless specified otherwise.
    b. Stainless steel (SS) ductwork shall be 18 gauge for kitchen hoods; and as required by SMACNA for other ducts. Materials shall be 316/No. 4 finish for exposed duct, 304/No. 1 finish for concealed ducts. Joints and seams shall be welded as required by SMACNA Guidelines for Welding Sheetmetal.
    c. Aluminum ductwork shall be Alclad 3003 1414 or alloy 5052 H32, for exhaust fan No. 2 duct system. Thickness as required by the SMACNA duct construction standards with Alloy 6061 bracing angles, and Pittsburgh lock longitudinal corner and double side seaming.
    d. Flexible Ductwork

        1) Flexible ductwork, connecting to uninsulated or unlined duct, shall be polyester core with corrosion resistant helical wire reinforcing. The polyester core shall be minimum two ply and shall have a minimum thickness of 0.0017". Flex duct shall be U.L. rated for 6" W.C. positive pressure, 2" W.C. negative pressure with a maximum velocity of 4000 FPM. Flexduct must be listed as a Class 1 Connector according to UL 181 and shall meet the requirements of NFPA 90A maximum ASTM E 84 fire hazard rating shall be 25 flame spread, 50 fuel contributed and 50 smoke developed. Uninsulated flexible duct shall be equivalent to Flexmaster Types 2 and 4 (not type 9).
        2) Flexible duct connected to insulated or lined duct shall also be insulated and shall be equivalent to Flexmaster Types 2 or 4 (not type 9), with 1 1/2", 3/4 lb. density fiberglass insulation and an aluminized reinforced vapor barrier.
        3) Submittals shall include data on no. of polyester plies and minimum thickness of polyester core, in addition to other data listed above required to ensure that submitted product meets the requirements of these specifications.
        4) If flexduct other than the model numbers of the vendors listed above is submitted, a sample of the flex shall be submitted to the Designer. The Designer shall have sole discretion in determining whether the submitted flex is equivalent to that of the named vendors above.
        5) Unless otherwise indicated, flexible duct shall not exceed 5'-0" long.

C. 2" and Lower Pressure Class Ductwork, Rectangular:

1. Ducts wider than 19" with more than 10 square feet of unbraced panel shall be beaded or cross broken.
2. Internal stiffening struts shall only be used upon prior written approval of the Designer.
3. Make changes in duct size with tapered connections as required by SMACNA. Changes shall NOT exceed 30°from line of air flow. Take off to the diffusers shall be 45° leading edge type or Bellmouth type.
4. Transverse joints shall be TDF/TDC or slip joints; use flat or standing seam according to SMACNA. Where duct size requires standing seam but space restrictions dictate flat seam, notify Designer prior to fabrication.

D. 2" and Lower Pressure Class Ductwork, Round:

1. Joints

   a. Longitudinal joints shall be spiral seam, butt welded, lap and seam welded, or ACME lock grooved seam. Snap lock seams shall be used on ½" w.g. pressure class duct only.
   b. Transverse joints shall be beaded sleeve joint or other approved joints listed in SMACNA. Use three or more sheet metal screws at 15" uniform intervals along circumference of joints.

2. Branch fittings shall be conical tee (Buckley or equal) or combination tee as shown in SMACNA.

E. 3" and 4" Pressure Class Ductwork Rectangular

1. Joints

   a. Joints shall be prefabricated type by TDC, TDF or Ductmate. See Prefabricated Joints paragraph for specific requirements.

2. Duct reinforcement spacing and type shall comply with SMACNA.
3. Ductwork on both sides of transitions shall be run in same horizontal axis.
4. Diverging section slope shall be 1 1/2" per foot or less if possible.
5. Contraction section slope shall not exceed 7" per foot.
6. Takeoffs shall be 45° leading edge type except that Bellmouths (Buckley or equal) may be used for takeoffs to terminal boxes if the distance between the box and point of takeoff is less than 8 ft.
7. Ducts with an aspect ratio greater than 3:1 shall be minimum of 18 gauge unless a thicker gauge is required by SMACNA.

F. 3" and 4" Pressure Class Ductwork, Flat Oval, Single Wall

1. Joints

   a. Ducts shall have spiral lock seams or longitudinal seams. Seams and joints in fittings shall be continuously welded. If coating is damaged during welding, repair joints to prevent corrosion.
   b. Transverse joints shall be slip or flanged.

G. 3" and 4" Pressure Class Ductwork, Round, Single Wall

1. Joints

   a. Longitudinal seams shall be lock spiral, lock longitudinal or butt welded longitudinal.
   b. Transverse joints shall be slip joints. Draw band joints shall be used on longitudinal seam duct only. Loose flange Vanstone joints may be used on ducts over 36" in diameter.
   c. Seams and joints in fittings shall be continuously welded. If coating is damaged during welding, repair joints to prevent corrosion.

2. Branch fittings shall be conical tee or combination tee as detailed in SMACNA.

H. Flexible Rigid Duct

1. Flexible ductwork shall be Flexmaster Triple Lock Buck Duct Flexible Air Duct (insulated) as manufactured by Buckley Associates or equal (617 878 5000). Flexible duct, non insulated, shall be Underwriters Laboratory Listed UL 181 Class 0 air duct and constructed in accordance with NFPA Standards 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
2. Duct shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and stability. The joint shall consist of a triple lock mechanically performed without the use of adhesives to make a durable airtight seam. A double lock is not acceptable.
3. Flexible duct connected to insulated or lined duct shall also be insulated. Flexmaster insulated flex shall have a gray Fire Retardant Polyethylene outer jacket with a ½ lb. density, 1 1/2" thick fiberglass insulation blanket, factory wrapped. Flexible Duct, insulated, shall be Underwriters Laboratory Listed and constructed in accordance with NFPA standards 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
4. The flexible duct shall be supported as required.
5. Flexible duct work shall be rated at 12" positive pressure. Duct from 3 to 16" shall have a negative pressure of 12", 8" for duct work 18 and 20.
6. All flexible duct shall be individually cartooned and labeled for delivery to the job site for maximum protection.
7. Submittals shall include data on minimum thickness of aluminum core, in addition to other data listed above, required to ensure that submitted product meets the requirements of these specifications.
8. Provide sealing compound for installation. See further paragraphs in this specification and details for other installation requirements.

I. Volume Dampers

1. Provide Young Regulator manual adjustable rectangular opposed blade dampers for duct heights less than 12" with factory installed locking hand quadrants extended 2" for all dampers installed in externally insulated duct:

   a. On each supply, return and general exhaust duct take off.
   b. At each take off to register, grille or diffuser (not all are shown on Drawing).

2. Dampers are manufactured approximately 5/16" smaller in width and 1/8" smaller in height than size of duct in which they are installed; e.g., nominal damper size is 24" x 10"; actual size is approximately 23 11/16" x 9 7/8".

3. Damper frame shall be constructed of #6063 extruded aluminum reinforced channel with minimum thickness of .050". Opposed damper blades shall be #6063 extruded aluminum with minimum thickness of .050" and shall include reinforcing ribs. Each blade shall be supported in the damper frame by individual Teflon axle bearings, and shall be driven by stainless steel connecting slide linkage controlled by 3/8" square steel control shaft.
4. Note: All required volume dampers may not be indicated on drawings but dampers shall be provided as necessary for systems balancing.
5. Dampers 12" and larger in height shall be opposed multi blade equal to Greenheck, Nailor, or Vent Products.
6. Where dampers are inaccessible, use Young Regulator locking type ceiling regulators and miter gear or worm gear for all horizontal dampers. Bearing coupling for bottom duct control may be used for shaft on vertical blade dampers. The 3/8" rod between ceiling regulator and damper shall be provided by contractor.
7. Damper blades shall be two gauges heavier than adjoining ductwork, and shall be riveted to supporting rods. Hem over edges parallel to rods.
8. Brackets shall be galvanized metal, secured to ductwork with sheet metal screw with locking quadrant arms (see seal class section for additional requirements). Provide 2" handle extension for all dampers on externally insulated ductwork.
9. Note: All required volume dampers may not be indicated on Drawings but dampers shall be provided as necessary for system balancing.

J. Automatic Dampers: Install automatic dampers furnished under Automatic Temperature Control Paragraph of this Section, as shown on Drawings, and as specified. Provide sealed wall penetrations for Seal Class A ductwork.

K. Locker Room Exhaust or Return Ductwork

1. Ductwork shall be aluminum, of types as detailed in this specification above and constructed in accordance with SMACNA except that Seal Class shall be "A" regardless of duct pressure rating.

L. Branch Duct Take off Fittings

1. Contractor shall provide Buckley Bellmouth Take offs at all branch duct locations.
2. Bellmouth Fitting shall be Model BMD with damper. In areas where sufficient duct height is not available, the contractor shall provide the Buckley Mini mouth fitting, Model M BMD with damper or the flat oval Bellmouth, Model FOBMD with damper.
3. Bellmouths shall be constructed of heavy duty galvanized steel. Bellmouths shall include an air tight Neoprene gasket to ensure a tight fitting with minimal leakage. Pre drilled holes shall be provided for quick mounting. Bellmouth shall be as manufactured by Buckley Associates or equal (617 878 5000).
4. Standard damper hardware to be constructed of 26 gauge galvanized material with a quadrant damper and tight fitting gasketing to ensure minimal leakage at damper pivot points.
5. Optional heavy duty hardware shall be provided at locations of higher static pressure where shown on the drawings.
6. Ninety degree take offs are not permitted on this project..

2.18 DUCTWORK ACCESSORIES

A. Dampers:

1. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct construction Standards".
2. Automatic Control Dampers: Refer to Division-23 section "Automatic Temperature Control" for control dampers; not work of this section.

3. Backdraft Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at .05" static pressure. Construct blades of 16-ga. aluminum, provide 1/2" diameter ball bearings, 1/2" diameter steel axles spaced on 9" centers. Construct from 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under: 4" x 1-1/4" x 16 ga. channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up. Provide felted or rubber trim to assure tight, leak-proof seal when closed.
4. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

    a. Air Balance, Inc.
    b. Airguarde Corp.
    c. American Warming & Ventilating, Inc.
    d. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
    e. Louvers & Dampers, Inc.
    f. Penn Ventilator Co.
    g. Ruskin Mfg. Co.
    h. Or equal

B. Fire Dampers:

1. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11-ga. galvanized steel. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated. Provide owner with a spare fusible link for each damper. Provide out of air stream type damper in open position and with positive lock in closed position, and with the following additional features:

    a. Damper Blade Assembly: Curtain type.
    b. Blade Material: Steel, match casing.
    c. Blade Material: Stainless steel.

2. Motor-Driven Fire/Smoke Dampers: Provide line voltage motor-driven fire/smoke dampers in types and sizes indicated on drawings, with casing constructed of 11-ga. galvanized steel with bonded red acrylic enamel finish, fusible link 160 to 165 degrees F (71 to 74 degrees C), unless otherwise indicated, and curtain type stainless steel interlocking blades, with electric motor equipped with instant closure clutch, stainless steel cable damper blade linkage, motor mounting bracket, and 32" long wire leads for connecting to smoke detector, and with the following construction features:

    a. Unit Assembly: Motor mounted outside air stream.

3. Manufacturer: Subject to compliance with requirements, provide fire dampers of one of the following:

    a. Air Balance, Inc.
    b. American Warming & Ventilating, Inc.
    c. Arrow Louver and Damper; Div. of Arrow United industries, Inc.
    d. Louvers & Dampers, Inc.
    e. Penn Ventilator Co.
    f. Phillips-Aires
    g. Ruskin Mfg. Co.
    h. Or equal

C. Turning Vanes:

1. Manufactured Turning Vanes: Provide double thickness airfoil turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set at 2" o.c, and set into side strips suitable for mounting in ductwork.

2. Manufacturer: Subject to compliance with requirements, provide turning banes of one of the following:

    a. Aero Dyne Co.
    b. Airsan Corp.
    c. Anemostat Products Div.; Dynamics Corp. of America.
    d. Barber-Colman Co.
    e. Duro Dyne Corp.
    f. Environmental Elements Corp.; Subs, Koppers Co., Inc.
    g. Hart & Cooley Mfg. Co.
    h. Register & Grille Mfg. Co., Inc.
    i. Souther, Inc.
    j. Or equal

D. Duct Hardware:

1. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

    a. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
    b. Quandrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2. Manufacturer: Subject to compliance with requirements. Provide duct hardware of one of the following:

    a. Ventbabrics, Inc.
    b. Young Regulator Co.
    c. Or equal

E. Duct Access Doors:

1. General: Provide duct access doors of a size as required to service and maintain device in duct. Provide on (1) access door at each control damper, humidifier, coil, fire damper, and any device that requires attention.
2. Construction: Construct of same or greater gauge as ductwork served, provide insulted doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.
3. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:

    a. Air Balance, Inc.
    b. Duro Dyne Corp.
    c. Register & Grille Mfg. Co., Inc.
    d. Ruskin Mfg. Co.
    e. Ventfabrics, Inc.
    f. Zurn Industries, Inc.; Air Systems Div.
    g. Or equal

F. Flexible Connectors:

1. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.
2. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

   a. American/Elgen Co.; Energy Div.
   b. Duro Dyne Corp.
   c. Flexaust (The) Co.
   d. Ventfabrics, Inc.
   e. Or equal

2.19 ACOUSTIC DUCT LINING

A. Lining for Rectangular Metal Ducts: All ducts, where shown or noted on the drawings, shall be lined with 1 ½ in. thick (R-6 min. performance) liner similar to Johns Manville "Permacote Linacoustic RC" fiberglass duct liner with factory-applied surface and edge coating. The lining can be less than 2" thick as long as code minimum R-6 is met. The liner shall meet the Life Safety Standards as established by NFPA 90A and 90B, FHC 25/50 and Limited Combustibility and the airstream surface coating should contain an immobilized, EPA-registered, anti-microbial agent so it will not support microbial growth as tested in accordance with ASTM G21 and G22. The duct liner shall conform to the requirements of ASTM C 1071, with an NRC not less than .75 as tested per ASTM C 423 using a Type "A" mounting, and a thermal conductivity no higher than .24 at 75EF mean temperature.

B. Material Handling and Storage: Liner shall be kept clean and dry during transportation, storage and installation. Care should be taken to protect the liner from exposure to the elements or damage from mechanical abuse.

C. Manufacturer: Subject to compliance with the above provide duct sound lining in accordance with the above performance criteria description.

2.20 SOUND ATTENUATORS (SA)

A. General: Provide factory-fabricated and tested duct silencers as indicated, select with performance characteristics which match, or exceed those indicated on schedule.

B. Casings: Construct of sheet metal, with gage and seam construction equal or greater than that recommended by SMACNA-Duct Construction Standards for ductwork of same size and pressure class; but not less than gauge dimension recommended by manufacturer to meet the DIL requirements based upon application (minimum 16-gage for outer casing and 20-gage for inner casing, refer to schedule for further info and requirements).

C. Acoustic Fill: Provide inorganic mineral or glass fiber filler material, inert, vermin and moisture proof, of sufficient density to obtain specified acoustic performance. Pack under not less than 5 percent compression to eliminate voids due to vibration and settling.

D. Acoustic Performance: Provide silencer ratings that have been determined in such to reverberative room test facility. Test silencer with air flow in both directions through silencer, in accordance with ASTM E477, "Methods of Testing Duct Liner Materials and Prefabricated Silencers for Acoustical and Airflow Performance."

1. For acoustic ratings, include Dynamic Insertion Loss and Self Noise Power Levels for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with airflow of at least 2,000 FPM face velocity.

E. Aerodynamic Performance: Provide silencers with static pressure loss equal to or less than that scheduled.

F. Certification: Provide certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance. Conduct all rating tests at same facility. Open testing facility for inspection by Architect/Engineer if requested.

G. Manufacturers: Subject to compliance with requirements, provide duct silencers of one of the following:

1. Vibro-Acoustics
2. Aeroacoustic Corporation
3. Price
4. Or Equal.

2.21 AIR OUTLETS AND INLETS

A. Ceiling Air Diffusers:

1. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Stamped face diffusers will not be acceptable.
2. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw, drop and noise criteria ratings for each size device as listed in manufacturer's current data.
3. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
4. Types: Provide ceiling diffusers of type, capacity, throw, blow and with accessories as listed on diffuser schedule.

a. Ceiling Diffusers shall be of the restricted multi-orificed jet induction and air mixing type consisting of louver sections with built-in diffusing vanes. The vanes shall be arranged to discharge air from adjacent louvers at an angle of 45 degrees in opposite directions to insure rapid mixing of primary and room air. Diffusing vanes shall be welded and mechanically fastened to the adjacent louver sections to make a rigid unit. The vanes shall extend to the discharge edges of the louvers. Where louver sections join the core frame, the louver ends shall be welded to the core frame. The leaving edge of each louver shall be hemmed and the louver ends shall be rounded and hemmed before welding to the core frames.
b. Diffusers shall be fabricated of aluminum or steel-welded construction, and shall be provided with a removable core permitting easy access to the neck connection. The diffuser neck shall extend no less than 1" above the core to accommodate an internal duct connection to prevent leakage into the ceiling space.
c. Finish shall be baked enamel. Color as selected by A/E.

d. Diffusers shall be steel of the fixed louvered face type with a minimum of four vaned assemblies. The louvered face shall be removable. The diffuser neck shall be sized to fit outside of the duct. Access to damper adjustment shall be provided through the face of the diffuser.
e. Diffusers shall be finished with a baked enamel color as selected by A/E.

5. Diffuser Dampers:

a. Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of diffuser. Provide in each ceiling diffuser.

6. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

a. Tuttle & Bailey Agitair Series “RC”
b. Metalaire – “5000 IV”
c. Nailor
d. Price Industries
e. Or equal

B. Wall Registers And Grilles:

1. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicted, and as required for complete installation.
2. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
3. Compatibility: Provide registers and grilles with border styles that are compatible with adjacent systems, and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of construction which will contain each type of register and grille.
4. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule:
5. Pattern: Register and grille patterns shall have style as identified on Drawings:
6. Dampers: Opposed Blade adjustable assembly, key operated from face of register.
7. Accessories:

a. Plaster Frame: Perimeter frame designed to act as plaster stop and register or grille anchor. Provide where required.
b. Operating Keys: Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustment.

8. Finish: Register and Grille Finishes shall be baked enamel color as selected by the Architect.
9. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one the following:

a. Tuttle & Bailey Agitair (Air Devices)
b. Carnes Co.
c. Titus Products Div.; Philips Industries, Inc.
d. Price Industries
e. Or equal

C. Ceiling Registers and Grilles:

1. General: Except as otherwise indicated, provide manufacturer's standard "Egg-Crate" type registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
2. Compatibility: Provide registers and ceiling grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling construction.
3. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule.
4. Register and Grille Materials:

    a. Aluminum Construction: Manufacturer's standard extruded aluminum frame and core.

5. Register and Grille Faces:

    a. 1/2" x 1/2" "Egg-Crate" with 1" border frame.

6. Register and Grille Dampers:

    a. Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of register (provide for registers only).

7. Register and Grille Finishes shall be baked enamel color as selected by the Architect.
8. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

    a. Tuttle & Bailey Agitair (Air Devices)
    b. Carnes Co.
    c. Titus Products Div.; Philips Industries, Inc.
    d. Price Industries
    e. Or equal

2.22 EXTRUDED ALUMINUM RAIN RESISTANT WALL LOUVERS

A. Air Construction Requirements

1. Louvers shall be model EHH as manufactured by Greenheck, or an approved equal. Louver frame shall be channel style with 0.081 inch extruded aluminum wall thickness. Louver blades shall be horizontal stationary style located on approximate 2 inch centers with 0.081 inch extruded aluminum wall thickness. Bird screen shall be internally mounted 0.75 inch x 0.051 inch flattened expanded aluminum. Finish of all materials shall be mill only. The Louvers shall be AMCA certified louvers

B. Performance Requirements

1. Louvers shall be AMCA Licensed when tested in accordance with AMCA 500-L Air Performance and Water Penetration test procedures. Free area for size 48 inch x 48 inch louver shall not be less than 6.72 square feet (42%). Airflow resistance at 1000 feet per minute free area intake velocity shall not be greater than 0.19 inch water gauge pressure drop. Airflow resistance at 1000 feet per minute free area exhaust velocity shall not be greater than 0.2 inch water gauge pressure drop. Beginning point of water penetration is above 1250 feet per minute free area intake velocity.
2. Louvers shall be designed and manufactured to withstand a minimum 25 pound per square foot wind load.

C. Provide the following Manufacturer's Options:

1. Clear Anodize (204-R1 Class II, or 215-R1 Class I)
2. Clip angles
3. 0.5 inch x 0.047 inch square stainless steel wire cloth bird screen

D. Manufacturer: Subject to compliance with requirements, provide louvers of one of the following:

1. Greenheck
2. Ruskin
3. Carnes
4. Or equal

2.23 CONDENSATE DISCHARGE PUMPS

A. General: Provide where indicated, condensate pumps of capacity as scheduled, to be field installed in various air handling equipment drain pans, consisting of ABS housing, pump, check valve, safety switch, and thermal overload protection. Factory assembled unit must be UL/CSA listed.

1. Condensate pumps shall require120V power; 208V-230V condensate pumps are not allowed.

B. High-Capacity Pumps

1. Reservoir: Construct of ABS plastic with a 3/10 capacity volume.
2. Pump: 25 GPH@15TDH vertical type pump with stainless steel motor shaft, rustproof, ABS volute, with safety switch.
3. Housing and Cover: Each shall be ABS plastic.
4. Manufacturers: Subject to compliance with requirements, provide high-capacity condensate pump of Little Giant or approved equal.

C. Low-Capacity Pumps

1. Pump: 8 GPH@33TDH reciprocating piston pump direct discharge with no storage reservoir.
2. Detection Unit: Low-maintenance filter free with a three level float (on/off/alarm).
3. Pump Housing and Detection Unit: Each shall be ABS plastic.
4. Manufacturers: Subject to compliance with requirements, provide low-capacity condensate pump of Sauermann or approved equal.

2.24 ACCESS DOORS

A. Refer to SECTION 08 31 10 for ACCESS DOORS AND FRAMES product requirements.

B. Furnish to the General Contractor for installation, and coordinate required rough openings with the General Contractor.

2.25 FIRESTOPPING AND SEALANTS

A. General – refer to Section 07 84 10 for firestopping material and installation requirements.

B. Firestopping of all penetrations as fire and smoke rated partitions.

C. Acoustical sealing of all penetrations in non-rated walls at each side of the wall with acoustic sealant as specified in section 07 92 00- joint sealants by the HVAC Subcontractor.

1. All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed. For applications where combustible penetrants are involved, i.e. insulated and plastic pipe, a suitable intumescent material must be used.
2. This section specifically addresses pipe, duct, cable, and wiring penetrations of fire wall firestops and smoke stops for all bearing and non-bearing walls and floors assemblies.

D. References

1. American Society For Testing and Materials Standards (ASTM):

   a. ASTM E 814: Standard Test method For Fire Tests of Through-Penetration Firestops
   b. ASTM E84: Standard Test Method For Surface Burning Characteristics of Building Materials

2. Underwriters Laboratories Inc.:

   a. UL 1479 Fire Tests of Through-Penetration Firestops

      1) UL 723 Surface Burning Characteristics of Building Materials

   b. UL Fire Resistance Directory:

      1) Through Penetration Firestop Device (XHJI)
      2) Fire Resistive Ratings (BXUV)
      3) Through Penetration Firestop Systems (XHEZ)
      4) Fill, Void, or Cavity Material (XHHW)

E. Definitions

1. Firestopping: The use of a material or combination of materials in a fire-rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating on that wall or floor.
2. System: The use of a specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), constitutes a "System".
3. Barrier: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.
4. Through-Penetration: Any penetration of a fire-rated wall or floor that completely breaches the barrier.
5. Membrane-Penetration: Any penetration in a fire-rated wall that breaches only one side of the barrier.
6. Construction Gaps: Any gap, joint, or opening, whether static or dynamic, where the top of a wall may met a floor; wall to wall applications, edge to edge floor configurations; floor to exterior wall; or any linear breach in a rated barrier. Where movement is required, the firestopping system must comply with UL2079 for dynamic joints.

F. Quality Assurance

1. Firestopping systems (materials and design):

   a. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
   b. The F rating must be a minimum of one (10 hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). the fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
   c. For joints, must be tested to UL2079 with movement capabilities equal to those of the anticipated conditions.

2. Firestopping materials and systems must be capable of closing or filling through openings created by 1) the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or 2) deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).
3. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.
4. Firestopping sealants must be flexible, allowing for normal pipe movement.
5. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.
6. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.
7. All firestopping materials shall be manufactured by one manufacturer (to the maximum extent possible).
8. Installation of firestopping systems shall be performed by a contractor (or contractors) trained or approved by the firestop manufacturer.
9. Material used shall be in accordance with the manufacturer's written installation instructions.

G. Materials

1. Intumescent Firestop Sealants and Caulks:

   a. STI SpecSeal S100 and S500 Sealant
   b. 3M Fire Barrier Caulk CP25WB+

2. Latex Firestop Sealant:

   a. STI SpecSeal LC150 Sealant

3. Silicone Firestop Sealants and Caulks:

   a. STI SpecSeal Pensil 100 and 300
   b. 3M Fire Barrier Silicone Sealants

4. Firestop Putty:

   a. STI SpecSeal Firestop Putty Bars and Pads
   b. 3M Fire Barrier Moldable Putty

5. Firestop Collars:

   a. STI SpecSeal Firestop Collars
   b. 3M Fire Barrier PPD's

6. Wrap Strips:

    a. SpecSeal Wrap Strip
    b. 3M Fire Barrier FS195 Wrap Strip

7. 2-Part Silicone Firestop Foam:

    a. STI SpecSeal Pensil 200
    b. 3M Fire Barrier 2001 Silicone Foam

8. Firestop Mortar:

    a. STI SpecSeal Mortar

9. Composite Board:

    a. 3M Barrier Sheet Material

10. Accessories:

    a. Forming/Damming Materials: Mineral Fiberboard or other type as per manufacturer recommendation.

2.26 CO/NO2 DETECTION AND CONTROL

A. Control Panel

1. The control panel shall provide continuous monitoring of the designated gas levels in the assigned area and control the ventilation system via digital outputs in accordance with all applicable codes and standards.
2. The control panel shall have the ability to interface via analog or digital outputs to any compatible electronic analog control, DDC/PLC control or automation system. Provide an upward communication BACnet protocol for BMS interface.
3. The control panel shall have the capability to accept any combination of 4-20 mA transmitters provided by the controller manufacturer.
4. The control panel shall accept up to 16 analog inputs with four (4) digital inputs. Each analog input can have five (5) trip/set-points.
5. There shall be five (5) relay outputs for every four (4) analog inputs and two (2) independent 4-20 mA outputs available. The outputs shall be programmable in the field. Each of the sensing points is readily addressable to either of the (2) analog outputs by selecting the Minimum, Maximum, or Average value.
6. The alarm shall be acknowledged by an external manual reset switch via the digital input or through the control panel menu.
7. The control panel shall have status indicator LED’s located on the front; Red = Fail, Yellow = Alarm.
8. The control panel shall include a two line, backlit LCD display of 16 characters, at 1 digit resolution.
9. The controller shall be NRTL performance tested and certified to ANSI/UL 2017.
10. The contractor shall supply the PolyGard® Series MGC2-16 analog controller, by INTEC Controls (a Relevant Solutions brand); or approved equal.

B. Carbon Monoxide (CO) Sensor/Transmitter

1. The carbon monoxide sensor/transmitter shall provide monitoring of the carbon monoxide levels in the parking garage and control the ventilation system via the control panel in accordance with all applicable codes and standards.

2. The sensors shall be electrochemical type. The sensor/transmitter shall have plug-in technology for ease of troubleshooting and replacement of both the element and the printed circuit board. Solid-state sensing devices shall not be acceptable.
3. The sensor range shall be 0-250 ppm carbon monoxide. A microprocessor-based transmitter shall generate a proportional 4-20 mA output signal. The wiring between the transmitter and the control panel shall be a 2-wire, twisted and shielded, 4-20mA, 17-28 VDC configuration. Each sensor/transmitter shall cover between 5,000 and 10,000 square feet of the garage floor and placement shall be applied strategically and appropriately per floor plan requirement.
4. The sensor shall have stability and resolution of ± 3 PPM of reading, repeatability of ± 3% of reading, and a response time of 50 seconds to a 90% step change. The long-term output drift shall not exceed more than 0.4% of signal loss per month. The permissible ambient working temperature shall be 14°F to 122°F (-10°C to 50°C) and permissible ambient humidity shall be 15 to 95% RH, non-condensing. The sensor shall require no routine maintenance other than periodic calibration. Its life expectancy shall be 5 years of normal service. The manufacturer shall provide a two 2-year warranty for materials and workmanship, and a 12-month warranty on the sensing element under normal exposure.
5. The sensor/transmitter printed circuit board shall have the capability of adding up to (2) alarm relays with individual setpoints for local control or status indication.
6. The sensor/transmitter shall be contained in a NEMA 4X metal enclosure. The enclosure for the sensor/transmitter shall be installed on walls or columns approximately 5 feet above the floor.
7. The output signal from the sensor/transmitter shall be a direct input to the control panel. All sequences of fan and alarm control, including time delay functions to prevent hunting of ventilation fans shall be a part of the control panel.
8. If the level of Carbon Monoxide reaches 25 PPM in the area of detection, the low alarm shall activate and the exhaust fans will be started. If the level of CO increases to 100 PPM, the high alarm shall activate.
9. The sensor/transmitter shall be NRTL performance tested and certified to ANSI/UL 2075.
10. The contractor shall supply the PolyGard® Series LC-1112 CO sensor/transmitter, by INTEC Controls (a Relevant Solutions brand); or an approved equal.

C. Nitrogen Dioxide (NO2) Sensor/Transmitter:

1. The Nitrogen Dioxide sensor/transmitter shall provide monitoring of the Nitrogen Dioxide levels present in diesel exhaust in the parking garage and control the ventilation system via the Control panel in accordance with all applicable codes and standards.
2. The sensors shall be electrochemical type. The sensor/transmitter shall have plug-in technology for ease of troubleshooting and replacement of both the sensing element and the printed circuit board. Solid-state sensing devices shall not be acceptable.
3. The sensor range shall be 0-10 ppm Nitrogen Dioxide. A micro-processor-based transmitter shall generate a polarity protected, proportional 4-20 mA output signal. The wiring between the transmitter and the Control panel shall be a 2-wire, twisted and shielded, 4-20mA, 17-28 VDC configuration. Each sensor/transmitter shall cover between 4,000 and 6,000 square feet of the garage floor and placement shall be applied strategically and appropriately per floor plan requirement.
4. The sensor shall have an accuracy and resolution of ±0.1 PPM of reading, repeatability of ±2% of reading, and a response time of less than 40 seconds to a 90% step change. The sensor drift shall not exceed more than 2% signal loss per month. The permissible ambient working temperature shall be 14°F to 104°F (-20°C to 40°C) and the permissible ambient humidity shall be 15 to 95% RH, non-condensing. The sensor shall require no routine maintenance other than periodic calibration. Its life expectancy shall be 2 years of normal service. The manufacturer shall provide a two 2-year warranty for materials and workmanship, and a 12-month warranty on the sensing element under normal exposure.
5. The sensor/transmitter shall be contained in a NEMA 4X enclosure. The enclosure with the sensor/transmitter shall be installed on walls or columns approximately 1.5 ft. above the floor.

6. The sensor/transmitter shall have the capability of adding up to (2) relays as a separate component to the printed circuit board of the sensor.
7. The output signal from the sensor/transmitter shall be a direct input into the digital control building automation system. All sequences of fan and alarm control, including time delay functions to prevent hunting of ventilation fans shall be a part of the Control panel.
8. If the level of NO2 reaches 2 PPM, the low alarm shall activate. If the level of NO2 increases to 5 PPM, the high alarm shall activate.
9. The contractor shall supply the PolyGard® Series AT-1130 NO2 sensor/transmitter, by INTEC Controls (a Relevant Solutions brand); or an approved equal.

D. Supplier:

1. The contractor shall supply all gas monitoring and control system by one manufacturer. The MGC-Series control panel, all associated gas transmitters and the SPC controller and associated gas transmitters are the basis of design by INTEC Controls (a Relevant Solutions brand), or approved equal.

E. Warranty:

1. The manufacturer shall provide a two 2-year warranty for materials and workmanship, and a 12-month warranty on the sensing element under normal exposure.

F. System:

1. The MGC2-16 shall monitor the following:

   a. Heated Parking 131: [5x] Carbon Monoxide and [5x] Nitrogen Dioxide sensors/transmitters
   b. Maintenance Bay 132: [1x] Carbon Monoxide and [1x] Nitrogen Dioxide sensors/transmitter.
   c. Wash Bay 133: [1x] Carbon Monoxide and [1x] Nitrogen Dioxide sensors/transmitter.

G. Manufacturer: Subject to compliance with requirements, provide gas detection system of one of the following:

1. Intec
2. Honeywell
3. Automation Components Inc.
4. Or equal

2.27 HEAT RECOVERY SYSTEM (VRF)

A. System Description:

1. Variable Refrigerant Flow (VRF) HVAC system shall be a direct expansion (DX) heat recovery system. The outdoor unit shall consist of one or more frames (modules) connected through common refrigerant piping and control communication wiring. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or mixed combinations) through a common refrigerant piping network and integrated system controls and communication network.
2. Heat recovery systems shall be a three-pipe design with the system ability to heat or cool simultaneously. The outdoor unit shall be an air cooled condensing unit with vertical discharge that uses refrigerant R-410A. The condensing unit may connect an indoor evaporator capacity up to 150% of the condensing unit capacity without any special factory approval. All zones are each capable of operating separately with individual temperature control.

3. Each indoor unit shall be controlled individually or as a group. Heat recovery systems shall operate in either the heating or cooling mode and shall support simultaneous heating and cooling mode.
4. 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.
5. The condensing unit shall be interconnected to indoor units of the same manufacturer in accordance with the manufacturer's engineering manual detailing each available indoor unit. The indoor units shall be connected to the condensing unit utilizing the manufacturer's specified piping joints and headers to ensure correct refrigerant flow and balancing. T-style joints are not acceptable for a variable refrigerant system.
6. Change-over Boxes shall be located as shown on the drawing(s). The Change-over Boxes shall control the operational mode of the subordinate indoor units.

B. 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 shall bear the listed mark.
2. All wiring shall be in accordance with the National Electric Code (NEC). The System shall be rated in accordance with Air Conditioning Refrigeration Institute (AHRI) Standard 1230 and bear the AHRI label.
3. The system shall be manufactured in an ISO 9001 and ISO 14001 facility, in accordance with the standards set by the International Standard Organization (ISO).
4. All units must meet or exceed the 2010 federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems.
5. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230 and ISO Standard 13256-1.

C. Indoor Unit System:

1. The system shall consist of multiple VRF indoor units, branch joints and headers. T-style joints shall not be permitted due to the large pressure differential through these fittings. The sum of connected capacity of all indoor units shall range from 55% to 150% of outdoor rated capacity. Up to 150% shall be possible without any factory approval for all capacities.

D. Outdoor Unit System:

1. The VRF outdoor unit shall be interconnected to the indoor units with capacities from 6,000 Btu/h to 96,000 Btu/h. Each VRF indoor unit or selected group of indoor units shall be capable of operating independently and be able to provide set temperatures through a wide variety of control options including simplified wired, wired, wireless, central station, computerized controller, LONWorks adapter, or BACnet adapter; a VRF H-Link Smart Gateway (BACnet) – Metasys compatible device that makes the VRF system viewable from all BACnet IP BMS/BAS systems; aWeb interface and automatic point mapping to the BMS; a VRF Cloud Gateway Device – VRF accessed through mobile device (tablet/phone using Android/iOS operating system); and a VRF compatible with Nest thermostat.
2. All components (compressor, controls, etc.) in the Outdoor Unit shall be easily accessible from the front for service/replacement.
3. The outdoor unit shall be coated with the Seacoast Protection Coating
4. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
5. Electronic terminals to be coated in compliance with ISO9277 standard.

E. Heating Defrost Operation:

1. The system shall have the ability to use a continuous heating defrost operation for multi-module system configurations.

F. Limited Warranty:

1. The units shall be covered by the manufacturer's limited warranty. The compressor shall have a manufacturer's limited warranty for a period of ten (10) years from date of unit installation. The unit's parts shall have a manufacturer's limited warranty for period of (10) years from date of unit installation.

G. VRF Installation:

1. The VRF system shall be installed by a factory trained contractor. The training should be performed by the manufacturer at a factory service and installation training facility.

H. Performance:

1. The three-phase VRF system performance shall be rated in accordance with AHRI 1230 test conditions.
2. The VRF system shall be listed in the AHRI directory.
3. The system efficiency shall meet or exceed the scheduled certified performance criteria

I. Operating Temperature Ranges:

1. The ambient air temperature operating ranges shall be as follows:

Category	Range (°F)
Cooling and simultaneous Cooling/Heating Standard Operating Range Cooling and simultaneous Cooling/Heating Extended Operating Range	23 – 122 -10 - 122
Heating Operating Range	-13 - 59
Cooling Mode - Indoor Temperature Range (WB)	59 - 73
Heating Mode - Indoor Temperature Range (DB)	59 - 80

J. Development Generations:

1. All three-phase VRF outdoor units connected to the same piping system shall be from the same product development generation. Mixing of outdoor units from different development generations in the same piping system is not acceptable.
2. Change-over Boxes and outdoor units in a system must be of the same product development generation.

K. Low Ambient Air Temperatures:

1. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions. Operations outside of these conditions are possible and may involve non-continuous operations.

   a. Outdoor Unit

      1) Cooling: 23°F DB to 122°F DB (With optional snow hood kit Accessories from 14°F DB to 122°F DB, With optional damper kit Accessories from -10°F DB to 122°F DB)
      2) Heating: -13°F WB to 59°F WB

L. General Features:

1. The air-conditioning system shall use R410A refrigerant.

2. The system shall be capable of an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed into the system.
3. Each system shall consist of one, two, or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.
4. Multiple frame configurations shall be field piped together using manufacturer-designed and supplied Y-branch kits and field-provided interconnecting pipe to form a common refrigerant circuit.
5. Refrigerant circuit configuration

    a. The refrigerant circuit shall be constructed using field-provided ACR copper, de-hydrated, and piped together with manufacturer-supplied Y- branches or headers connected to multiple (ducted, non-ducted or mixed combination indoor units to effectively and efficiently control heating or cooling operation of the VRF system. Other pipe materials shall not be allowed.
    b. Each refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. Insulation R-value (thickness) shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be allowed to be compressed at any point in the system.
    c. The condensing unit will be factory charged with R-410A.
    d. Depending on the size and length of the piping when installed, it may require additional trim charging in the field.
    e. The condensing unit shall include a refrigerant charge volume analyzer that includes an automatic refrigerant assessment system to check whether or not the correct amount of refrigerant charge exists in a given refrigerant cycle.

M. Electrical:

1. The condensing unit power supply shall be 208/230V 3 phase, 60 Hertz per schedule.
2. The condensing unit shall have an acceptable voltage range of 187-253V.
3. The control circuit between the condensing unit, changeover boxes, and indoor units shall use AWG18-2 type control wire.

N. Safety:

1. The condensing unit shall include protection devices including a high pressure switch at 4.15 MPa (601psi), over current protection for the inverter and for the PCB, and over heat protection for the inverter and the compressor.

O. Energy Savings:

1. The system shall be equipped with power demand limiting control possibility which prevents excessive energy consumption during peak operating conditions and automatically detects electric current flow and prevents the system from using too much energy.

P. Change-Over Boxes (COB):

1. General

    a. The change-over boxes are designed specifically for use with VRF heat recovery system.
    b. The change-over boxes shall be factory assembled, wired, piped and run tested at the factory.
    c. Multiple indoor units may be connected to a port provided they are within the capacity range of the port.

2. Valves

    a. The unit shall be furnished with electronic expansion valves to control the direction of refrigerant flow in each branch. Use of solenoid valves shall not be acceptable due to noise.

3. Condensate Removal

    a. The unit shall not require provisions for condensate removal

Q. Indoor Unit – 4-Way Cassette – (FCU):

1. General:

    a. The unit shall have the ability to be recessed into the ceiling with a ceiling grill and shall be a 4-way air distribution type.
    b. The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.
    c. The unit and refrigerant pipes will be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.
    d. The 4-way cassette shall be equipped with an electronic expansion valve.
    e. All sizes of 4-Way Cassettes shall be equipped with a built-in condensate pump with 33.5” lift.
    f. The unit shall have an automatic louver control.
    g. The 4-way cassette shall be able to be configured for 2-way or 3-way airflow as well.
    h. The 4-way cassette shall be available with optional energy-saving motion and radiant heat sensor for optimized airflow and temperature control.

2. Performance:

    a. Each 4-way cassette’s performance is based on nominal operating conditions shown in mechanical schedules.

3. Unit Cabinet:

    a. The unit cabinet shall be space saving and have the ability to be recessed into a ceiling.
    b. The 4-way panel shall be affixed to the bottom of the unit allowing for 4-way airflow.
    c. The 4-way cassette (without panel) shall be no larger than 33-5/64” x 33-5/64” and weigh no more than 57 lbs.
    d. An outside air knockout shall exist to for branch ducting supply air.

4. Fan:

    a. Unit shall be equipped with a brushless DC fan motor drive.
    b. The 4-way cassette shall consist of four fan speeds including: low (Lo), medium (Me), high (Hi), and high 2 (Hi2).

5. Filter

    a. The standard 1” air filter shall be made of an anti-mold polypropylene that is also a washable type.

6. Sound:

    a. The 4-way cassette sound pressure shall range 27 dB(A) to 35 dB(A) at low speed.

7. Electrical:

    a. The unit shall be 208-230V, 1 phase, 60 Hertz.
    b. The 4-way cassette shall have an acceptable voltage range of 187-255V.
    c. The control circuit between the units in the system shall use AWG18-2 type control wire.

R. Indoor Unit – Wall Mount – (FC):

1. General:

    a. The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.
    b. The unit and refrigerant pipes will be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.
    c. The unit shall have an automatic wide angle louver control.
    d. The unit shall have a removable front panel for easy cleaning.
    e. The unit shall have an auto-swing function to ensure efficient air distribution and uniform temperature.
    f. The unit shall have a built-in wireless sensor.

2. Performance:

    a. Each wall mount indoor unit's performance is based on nominal operating conditions shown in the mechanical schedules.

3. Unit Cabinet:

    a. The wall mount indoor unit shall be no larger than 13-1/8" x 45-9/32" x 9-21/32" and weigh no more than 40 lbs.
    b. The unit shall be affixed to a separate galvanized steel back plate to secure the unit firmly to the wall.

4. Fan:

    a. Unit shall be equipped with a brushless DC fan motor drive.
    b. The wall mount shall consist of four fan speeds including: low (Lo), medium (Me), high (Hi), and high 2 (Hi2).

5. Filter

    a. The standard 1" air filter shall be made of an anti-mold polypropylene that is also a washable type.

6. Sound:

    a. The wall mount indoor unit sound pressure shall range 30 dB(A) to 41 dB(A) at low speed.

7. Electrical:

    a. The unit shall be 208-230V, 1 phase, 60 Hertz.
    b. The wall mount indoor unit shall have an acceptable voltage range of 187-255V.
    c. The control circuit between the indoor units shall use AWG18-2 type control wire.

8. Piping:

    a. Refrigerant and drain piping shall have the ability to be connected at the right, left or rear of the unit for ease of installation.

S. Controllers:

1. VRF SMART GATEWAY

    a. Supports up to 64 VRF systems, up to 160 Indoor Units, and up to 200 total Indoor and Outdoor Units
    b. Integrates with the Metasys and FX building automation systems
    c. Integrates with third party building automation systems supporting the BACnet IP protocol
    d. BACnet Gateway (B-GW) device profile
    e. BACnet IP, (Annex J), BACnet Broadcast Management Device (BBMD)"
    f. Connects up to 4 Large Central Controllers simultaneously
    g. Includes a Wi-Fi antenna for access via Laptop, Smartphone, etc.

T. Manufacturer: Subject to compliance with requirements, provided valve control box of one of the following:

1. Daikin
2. Mitsubishi
3. LG
4. Or Equal

2.28 VEHICLE EXHAUST REMOVAL SYSTEM

A. Self-contained, fully automatic, recirculating, hoseless system with intake and clean air output; designed to remove hazardous gases and particulate from indoor vehicle parking bays and eliminate exhaust backwash in accordance with ANSI/ASHRAE 52.2, UL 508A, UL 900, ULC/CAN S111 and NFPA 1500.

1. Description: Single zone system with total number 7 units, as shown on drawing M102
2. Components:

    a. Cabinet body: Includes 4 pre-drilled mounting holes and 4 2 inch × 2 inch × 3/16 inch (51 mm × 51 mm × 4.8 mm) thick mounting angles for chain suspension or threaded-rod hangers; 8 feet (2438 mm) 3-prong, 14 gauge pre-molded electrical cord; adjustable airflow grilles; hinged access panels with access panels for access to motor blower unit and filter compartment; automated filter replacement gauge and electrical connection box.

        1) Material and finish: 18 gauge steel with powder coat finish.

    b. Filters:

        1) Pre-Filter: 24 inch × 24 inch × 1 inch (610 mm × 610 mm × 25 mm); 3 ply polyester construction; self sealing; meeting requirements for Class 2 in accordance with UL 900 and ULC/CAN S111. Certified efficiency of 30 to 35 percent based on ASHRAE 52.2 test method.

2) Main Media Filter: 24 inch × 24 inch × 6 inch (610 mm × 610 mm × 152 mm); HEPA MAX 3000 high efficiency particulate air filter, with ultra-fine pleated fiberglass media pack; constructed with 24 gauge galvanized metal frame and corrugated aluminum dividers between pleats; meeting requirements for Class 2 in accordance with UL 900 and MERV 16. Certified efficiency of 95 to 99.97 percent based on dioctyl phthalate (DOP) testing with 0.3 micrometer particles. Maximum filter media weight is 16 lb (7.3 kg) for main filter.
3) Gas-Phase Extractor: 24 inch × 24 inch × 4 inch (610 mm × 610 mm × 102 mm) deep; 2-part gas phase extractor with activated carbon filter for removal of heavy weight gases and potassium permanganate filter for removal of light weight gases. Heavy and light weight filters are each constructed with 24 gauge galvanized metal frame and honeycomb containment structure. Maximum filter media weight is 28 lb (12.7 kg) for both gas-phase filters.

c. Motor-Blower Unit: Dual voltage, ball bearing, resilient mounted, capacitor start, thermally protected, UL approved electric motor; with plastic chemical resistant, back curved, 14 inch × 7 33/64 inch (356 mm × 191 mm) centrifugal impeller and airflow funnel cone.

1) Motor: 1 HP, 115 V, 1 phase, 50-60 Hz, 14.7 FLA.

d. Automatic Vehicle Exhaust Control System: NEMA 4, 120 V electrical controller designed to operate and sequentially activate exhaust removal units in groups of two, after 15 second delays, until all units are activated, including: adjustable low voltage time delay relay; LED “System Activated” indication light; ON-OFF-AUTO selector, “System Test” switch to activate system for a timed cycle; 120 V to 24 V, 2A low voltage transformer to power system activation devices; meeting UL 508 for industrial enclosed control panels.
e. System Activation Devices:

1) Standard magnetic door switches and photoelectric eye switches.
2) Combination carbon monoxide and nitrogen dioxide detectors.

3. Installation: Ceiling-hung with chain or threaded rod, between vehicle bays as detailed on drawing M102. Power is required to each unit through the electrical controller. Low-voltage wiring and connections are necessary for activation devices.

B. MANUFACTURER

1. Vehicle Exhaust System is a Proprietary item as determined by the Town of North Reading provide the following:

a. AirVac
b. AirHAWK
c. Or equal

2.29 AUTOMATIC TEMPERATURE CONTROLS (DDC)

A. Basic Components and Systems:

1. General: Provide control products in sizes and capacities indicated, consisting of dampers, thermostats, clocks, sensors, controllers, and other components as required for completed installation. Except as otherwise indicated, provide manufacturer’s standard materials and components as published in their product information, designed and constructed as recommended by manufacturer and as required for application indicated. All equipment and systems shall be installed by factory trained contractors with the following functional and construction features.

2. The building automation system shall be based on a Niagara open protocol BacNet system infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard ie Lon, Modbus or software) into a unified platform that can be read and written to and easily managed in real time using a standard Web browser. Systems not developed on a Niagara BacNet protocol are unacceptable. The building automation system shall not require licensing fees and shall be licensed indefinitely to the Owner for use at the project site. ATC manufacturer shall provide written confirmation that installing ATC Contractor is an authorized dealer and service provider. The ATC system provided must be capable of being serviced by three or more local authorized vendors/contractors.

    a. The Niagara Compatibility Statement (NICS) for all Niagara Software shall allow open access and be set as follows: accept.station.in="*" accept.station.out="*" accept.wb.out="*" accept.wb.in="*". In any case, the end user shall maintain the right to instruct the contractor to modify any software license, regardless of supplier, as desired by the end user. The contractor shall not install any “brand-specific” software, applications or utilities on Niagara Framework-based devices.
    b. All hardware and field-level devices installed shall not be limited in their ability to communicate with a specific brand of Niagara Framework JACE. They shall also be constructed in a modular fashion to permit the next generation and support components to be installed, in replacement of or in parallel with existing components. All controllers must be able to be programmed within the Niagara Workbench.
    c. At the completion of the project, the owner shall be given all existing platform and station login credentials to include; super user (admin) user names; passwords and passphrases.

3. Provide all required control wiring including CAT6 Ethernet wiring for any controllers requiring Ethernet connectivity. Terminate Ethernet cable in MDF and IDF closets on patch panels proceed under Technology Section 270000.
4. Install an open-protocol (BACNet) energy management system (EMS) to monitor and trend the energy consumed by the following systems throughout the school:

    a. HVAC systems
    b. Hot and cold domestic water systems
    c. Main electric service meter
    d. Main gas meter

5. The ATC control and building EMS system shall have the following attributes with characteristics and performance as specified within this Specification section, related Electrical and Plumbing section specifications and the Control Diagram drawings:

    a. Sensors as follows:

        1) Sensors to trend outdoor air temperature
        2) Indication and trending of damper and valve commanded positions.
        3) Sensors to monitor building electrical and natural gas consumption. Main service electrical meters shall be provided by the Electrical Contractor and control wiring from the meter to the EMS system shall be provided by the ATC contractor. Domestic hot water scope shall be relays on each domestic water heater burner and through BMS programming utilizing burner on/off operation domestic hot water consumption will be determined, all provided by the ATC Contractor.
        4) Sensors to monitor indoor and outdoor CO2.
        5) Sensors to monitor and trend (create trend logs) controlled variables at the operator interface. Control variables may include air and/or water flow, temperature, pressure, CO2, and pump or fan speed. Relevant multiplexed data from microprocessors located in chillers, boilers, variable speed drives and other equipment with multiplexing capabilities may be used in lieu of specifying separate sensors.

6) All densely occupied spaces, with occupant density of 25 people or more per 1000 s.f. must be provided with CO2 sensors per LEED IEQC1 requirements. Provide multi functioning sensors with temperature, humidity and CO2 for each classroom space, gym, cafe, media center, life skills rooms, special needs, auditorium, stage, band room, music room and robotics.

b. Points matrix – including all hardwired input and output devices connected to the automation system, all set points, upper and lower control limits.
c. Trend capabilities – including a trend point list and preprogrammed sample of point (performed by controls contractor), sample rate, storage interval, upload interval, custom trend abilities, alarms, and automated trend data review and notification (automated diagnostics).
d. System architecture – capable of allowing sampling of these points to facilitate building commissioning and diagnostics without significantly affecting system performance.
e. Data storage system – with adequate capacity to record trend data for use by building operators. Data export requirements must facilitate user-friendly data access and manipulation.
f. Operator interface – designed for remote/web access, monitoring requirements, trend-log reporting and diagnosing building problems through a user-friendly interface. This includes providing a visual (non text based) operations and reporting interface to facilitate rapid system assessment that utilizes color-coding, diagrams of floor plans and graphing capabilities.
g. The remote access shall use a web browser only and not require a VPN with remote desktop application.

6. Electric Wiring: All electric wiring and wiring connections, either line voltage or low voltage, from the emergency electric panels to the ATC panels, and from the ATC related panels to the individual control devices i.e. rooftop units, exhaust fans, boilers, chillers, valves, and dampers required for the installation of the control system, as herein specified shall be provided by the control contractor unless specifically shown on the electrical drawings or called for in the electrical specifications.

a. The wiring installation shall be in accordance with National and Local Codes and with the Electrical portion of these specifications. All wiring shall be run concealed wherever possible. Exposed wiring in occupied areas shall be run in raceways. Raceways shall be Wiremold 200 series with all elbows, raceways, covers, mounting stops, box extensions and wiring for a complete and neat installation. All wiring located in mechanical spaces, boiler rooms, and fan rooms shall be installed in metal conduit
b. All wiring above ceilings, in boiler rooms, and all mechanical spaces shall follow routing of piping and where not possible shall be in conduit. All exposed wire shall be bundled and wire tied and shall be supported to adjacent piping. Draped and free floating wire will not be allowed.
c. All terminations of wire at control devices shall be looped and supported adequately.
d. All wiring shall comply with the requirements of the electrical section of the specification.

7. All appliances, controllers, and servers provided shall include the licenses for full, bidirectional (import & export) support for BACnet/IP and BACnet/MS/TP. These drivers shall be installed, tested, and commissioned to permit BACnet communications at the IP and MS/TP levels.
8. BACnet MS/TP shall be used as the communications protocol between the network controllers and the field controllers. All objects in the field controllers shall be exposed as BACnet objects and accessible through network controllers.

9. The controls contractor shall provide, install and configure fully licensed copies of all necessary BAS manufacturers' software and tools to engineer, develop, configure, program, and test control sequences in the network controllers and in the field controllers, and user interface screens and graphics in the network controllers and system server as provided on this project. The controls contractor shall provide full documentation and backup file copies of all system, controller, and user interface configuration, programming, screens, user interface screens and graphics. With the software tools and backup files, it will be possible for the owner or any trained person or company contracted by the owner to make any changes they deem necessary to the system, to the controllers, and/or to the user interface, without having to use the original controls contractor.

B. Controls Systems Wiring

1. All conduit raceways, wiring, accessories and wiring connections required for the installation of the Controls Systems shall be provided by the Controls Contractor except as shown on the Electrical Drawings. All wiring shall comply with the requirements of applicable portions of the Electrical Section 26 00 10 and all local and national electric codes and the requirements of the AHJ.
2. All Controls Systems wiring materials and installation methods shall comply with the original equipment manufacturer recommendations and standards.
3. The sizing type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the Controls Contractor.
4. Class 2 Wiring

    a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
    b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5ft. from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines.

5. Class 2 signal wiring and 24VAC power may be run in the same conduit. Power wiring 120VAC and greater shall not share the same conduit with Class 2 signal wiring.
6. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:

    a. All circuits are continuous and free from short circuits and grounds.
    b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms.
    c. All circuits are free from induced voltages.

7. Provide complete testing for all cables and wiring. Provide all equipment, tools, and personnel as necessary to conduct these tests.
8. Provide for complete grounding of all signal and communication cables, panels and equipment so as to ensure integrity of Controls Systems operation. Ground cabling and conduit at panel terminations. Do not create ground loops.

C. Line Voltage Power Sources

1. 120-volt AC circuits for the Controls Systems shall be taken by the Controls Contractor from electrical emergency panelboards and circuit breakers as designated on the electrical drawings.
2. Circuits used for the Controls Systems shall be dedicated to these Controls Systems and shall not be used for any other services.
3. Controls DDC terminal unit controllers may use 120-volt AC power from motor power circuits.

D. Controls Systems Raceways

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in the Specification. Minimum conduit size 3/4 in.
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the supporting surface.
4. UL/ULC Listed Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 ft. in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls and for final connection to equipment.

E. Penetrations

1. Firestopping for all penetrations used by dedicated Controls Systems conduits and raceways shall be by other trades.
2. All openings in fire proofed or fire stopped components shall be closed by other trades using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls, shall be in sleeves, conduit or enclosed raceway.
4. No penetrations through building structural elements, slabs, ceilings and walls shall be made before receipt of written approval from the Architect.

F. Controls Systems Identification Standards

1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node environmental location.
2. Cable shall be labeled at every termination with cross-referencing to record documentation.
3. Raceway Identification: Exposed covers to junction and pull boxes of the FMS raceways shall be identified at primary points.
4. Wire Identification: All low and line voltage wiring shall be identified by a number, as referenced to the associated shop and record drawing, at each termination.
5. Wires and cabling shall not be spliced between terminations. Cable shields shall be single end grounded – typically at the panel end outside the panel.
6. Suggested color coding, for use at the Contractors option, are:

a.	Analog Input Cable	Yellow
b.	Analog Output Cable	Tan
c.	Binary Input Cable	Orange
d.	Binary Output Cable	Violet
e.	24 VAC Cable	Gray
f.	General Purpose Cable	Natural
g.	Tier 1 Comm Cable	Purple
h.	Other Tier Comm Cable	Blue
i.	Ethernet cable	Blue

7. Provide permanent identification labels at all valve and damper actuators to indicate open and closed positions.

G. Field Panel And Device Installations And Locations

1. The Controls Systems panels, enclosures and cabinets shall be located as coordinated with the Architect at an elevation of not less than 2 ft. from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer’s recommendations.
2. All field devices shall be installed per the manufacturer recommendation and in accessible locations as coordinated with the Architect.

3. Panels to be located in damp areas or areas subject to condensation shall be mounted with wall standoffs.
4. Conduit configurations entering or leaving panels and devices shall be such as to preclude condensation traps.
5. Networking Communications
6. The design of the BAS shall network operator workstations and stand-alone DDC Controllers. The network architecture shall consist of multiple levels for communication efficiency, a campus-wide (Management Level Network) Ethernet network based on TCP/IP protocol, high performance peer-to-peer building level network(s) and DDC Controller floor level local area networks with access being totally transparent to the user when accessing data or developing control programs.
7. System shall communicate with a BACnet network over Ethernet or BACnet/IP (according to Annex J). The intent is to use the system provided under this contract to communicate with control systems and/or devices provided by other vendors. A PICS must be provided describing the BACnet, ANSI/ASHRAE 135-95, implementation. The product shall be Network Application Engine level 1 controllers with field equipment controller for level 2 controllers no substitutions. Minimum system functionality must include monitoring, commanding, and alarming for daily operator functions from a common workstation.

    a. System shall have the capability to be an OPC Client and Server for dynamic communication with OPC Clients or Servers over an Ethernet network. At a minimum, the following must be supported:

        1) Data Access 1.0 (96), 1.0A (97) and 2.0 (11/98)
        2) Alarms & Events 1.0 (1/99)

8. Network Switches

    a. Provide HP ProCurve 2910 al series 2910-48G al 48 ports network switch Brocade, Cisco or equal in MDF/IDF rooms as required.

9. Ethernet Wiring

    a. Ethernet wiring shall be CAT6 UTP cable plenum rated. CAT6 UTP cables shall conform to ANSI/TIA/EIA-568-B1, B2, B3 Commercial Building Telecommunications Cabling Standard (latest amendment and including all applicable addenda) and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard (latest amendment and including all applicable addenda).

10. Building Data Network:

    a. All operator devices either network resident shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the network. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.
    b. The network shall support a minimum of 100 DDC controllers and PC workstations
    c. The system shall support integration of third party systems (fire alarm, security, lighting, PLC, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for interprocess control. All exchange points shall have full system functionality as specified herein for hardwired points.
    d. Field panels must be capable of integration with open standards including Modbus, BACnet, and Lonworks as well as with third party devices via existing vendor protocols.
    e. The Building Network shall use the TCP/IP over Ethernet. All devices must:

f. Auto-sense 10/100/1000 Mbps networks.

1) IP Address will be assigned by Owner's IT staff.
2) DNS and Gateway IP address will be provided by Owner's IT staff. A VLAN will be setup by Owner's IT staff.
3) Allow access using Telnet.

11. Internet access

a. Web Based Operator Interface

1) The BAS shall provide a web based graphical interface that allows users to access the BAS data via the Internet. The interface shall use HTML based ASP pages to send and receive data from the BAS to a web browser.
2) All information exchanged over Internet shall be encrypted and secure via SSL.
3) Access to the web interface will be password protected. A users rights and privileges to points and graphics will be the same as those assigned at the BAS workstation. An option will exist to only allow users "read" access via the web browser, while maintaining "command" privileges via the BAS workstation.
4) Commissioning of the Web interface shall not require modification or creation of HTML or ASP pages. All graphics available at the BAS graphical workstation shall be available to users via a web browser.
5) The web-based interface shall provide the following functionality to users, based on their access and privilege rights:

(a) Logon Screen – allows the user to enter their user name, password and Domain name for logging into the web server.
(b) Alarm Display – a display of current BAS alarms to which the user has access will be displayed. Users will be able to acknowledge and erase active alarms, and link to additional alarm information including alarm messages, and informational and memo text. Any alarm acknowledgements initiated through the web interface will be written to the BAS central workstation activity log.
(c) Graphic Display – Display of system graphics, including animated motion, available in the BAS workstation will be available for viewing over the web browser. Software that requires creation of dedicated "web" graphics in order to display them via the browser interface will not be acceptable. A graphic selector list will allow users to select any graphics to which they have access. Graphic displays will automatically refresh with the latest change of values. Users will have the ability to command and override points from the graphic display as determined by their user accounts rights.
(d) Point details – users will have access to point detail information including operational status, operational priority, physical address, and alarm limits, for point objects to which they have access rights.
(e) Point Commanding – users will be able to override and command points they have access to via the web browser interface. Any commands or overrides initiated via the web browser interface will be written to the BAS central workstation activity log.

12. The web server licensing options will allow concurrent access by 10 browser connections.
13. Internet connections, ISP services, as well as necessary firewalls or proxy servers shall be provided by the Owner as required to support the web access feature.

H. DDC Controller Floor Level 2 Network

1. This level communication shall support a family of application specific controllers and shall communicate with the network through DDC Controllers for transmission of global data.

I. DDC & HVAC Mechanical Equipment Controllers

1. The DDC and HVAC Mechanical Equipment Controllers shall reside on the Building Level Network.
2. DDC and HVAC Mechanical Equipment Controllers shall use the same programming language and tools. DDC and HVAC Mechanical Equipment Controllers which require different programming language or tools on a network are not acceptable.
3. DDC and HVAC Mechanical Equipment Controllers which do not meet the functions specified are not acceptable.

J. DDC Controller

1. DDC Controllers shall be a 16-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point I/O schedule. Each controller shall support a minimum of three Floor Level Application Specific Controller Device Networks.
2. Each DDC Controller shall have 72 Megabytes of memory to support its own operating system and databases, including:

    a. Control processes
    b. Energy management applications
    c. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
    d. Historical/trend data for points specified
    e. Maintenance support applications
    f. Custom processes
    g. Operator I/O
    h. Dial-up communications
    i. Manual override monitoring

3. Each DDC Controller shall support firmware upgrades without the need to replace hardware.
4. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
5. DDC Controllers shall provide a RS-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. DDC Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.
6. As indicated in the point I/O schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.

    a. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
    b. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

7. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
8. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
9. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:

    a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V
    b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact
    c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power
    d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)
    e. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:

        1) IEEE Standard 587-1980
        2) UL 864 Supply Line Transients
        3) Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)

10. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.

    a. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
    b. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

11. Provide a separate DDC Controller for each AHU or other HVAC system as indicated in Section 3.02. It is intended that each unique system be provided with its own point resident DDC Controller.

K. HVAC Mechanical Equipment Controllers

1. HVAC Mechanical Equipment Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.
2. Each HVAC Mechanical Controller shall have 72 Megabytes of memory to support its own operating system and databases, including:

    a. Control processes
    b. Energy management applications
    c. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
    d. Historical/trend data for points specified
    e. Maintenance support applications
    f. Custom processes
    g. Operator I/O
    h. Remote communications

3. HVAC Mechanical Equipment Controllers shall provide a RS-232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals.
4. HVAC Mechanical Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.
5. Each HVAC Mechanical Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Mechanical Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
6. In the event of the loss of normal power, there shall be an orderly shutdown of all HVAC Mechanical Equipment Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

    a. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.
    b. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

L. DDC and HVAC Mechanical Equipment Controller Resident Software Features

1. General:

    a. The software programs specified in this Section shall be provided as an integral part of DDC and HVAC Mechanical Equipment Controllers and shall not be dependent upon any higher level computer for execution.
    b. All points shall be identified by up to 30 character point name and 16 character point descriptor. The same names shall be used at the PC workstation.
    c. All digital points shall have user defined two-state status indication (descriptors with minimum of eight characters allowed per state (i.e. summer/winter).

2. Control Software Description:

    a. The DDC and HVAC Mechanical Equipment Controllers shall have the ability to perform the following pre-tested control algorithms:

        1) Two-position control
        2) Proportional control
        3) Proportional plus integral control
        4) Proportional, integral, plus derivative control
        5) Automatic tuning of control loops

3. DDC and HVAC Mechanical Equipment Controllers shall provide the following energy management routines for the purpose of optimizing energy consumption while maintaining occupant comfort.

    a. Start-Stop Time Optimization (SSTO) shall automatically be coordinated with event scheduling. The SSTO program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by time of occupancy. The SSTO program shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions.

        1) The SSTO program shall operate in both the heating and cooling seasons.

            (a) It shall be possible to apply the SSTO program to individual fan systems.
            (b) The SSTO program shall operate on both outside weather conditions as well as inside zone conditions and empirical factors.

        2) The SSTO program shall meet the local code requirements for minimum outside air while the building is occupied.

    b. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or groups of points according to a stored time.

        1) It shall be possible to individually command a point or group of points.
        2) For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start or stop within that group.
        3) The operator shall be able to define the following information:

            (a) Time, day
            (b) Commands such as on, off, auto, and so forth.
            (c) Time delays between successive commands.
            (d) There shall be provisions for manual overriding of each schedule by an appropriate operator.

        4) It shall be possible to schedule events up to one year in advance.

            (a) Scheduling shall be calendar based.
            (b) Holidays shall allow for different schedules.
            (c) Enthalpy switchover (economizer) The Energy Management Control Software (EMCS) will control the position of the air handler relief, return, and outside air dampers. If the outside air dry bulb temperature falls below changeover set point the EMCS will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.
            (d) Temperature-compensated duty cycling.
                - The DCCP (Duty Cycle Control Program) shall periodically stop and start loads according to various patterns.
                - The loads shall be cycled such that there is a net reduction in both the electrical demands and the energy consumed.
            (e) Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.
            (f) Night setback control: The system shall provide the ability to automatically adjust setpoints for night control.
            (g) The Peak Demand Limiting (PDL) program shall limit the consumption of electricity to prevent electrical peak demand charges.

- PDL shall continuously track the amount of electricity being consumed, by monitoring one or more electrical kilowatt-hour/demand meters. These meters may measure the electrical consumption (kWh), electrical demand (kW), or both.
- PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.
- If the PDL forecasted demand indicates that electricity usage is likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads.
- Once the demand peak has passed, loads that have been shed shall be restored and returned to normal control.

4. DDC and HVAC Mechanical Equipment Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

    a. A single process shall be able to incorporate measured or calculated data from any and all other DDC and HVAC Mechanical Equipment Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC and HVAC Mechanical Equipment Controllers on the network. Database shall support 30 character, English language point names, structured for searching and logs.
    b. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.
    c. DDC and HVAC Mechanical Equipment Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task orientated information from the user manual.
    d. DDC and HVAC Mechanical Equipment Controller shall be capable of comment lines for sequence of operation explanation.

5. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC and HVAC Mechanical Equipment Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC and HVAC Mechanical Equipment Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

    a. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
    b. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller) to provide full flexibility in defining the handling of system alarms. Each DDC and HVAC Mechanical Equipment Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
    c. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs based on time (after hours destinations) or based on priority.
    d. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
    e. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.

6. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.

    a. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC and HVAC Mechanical Equipment Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of l minute to seven days shall be provided. Each DDC and HVAC Mechanical Equipment Controller shall have a dedicated RAM-based buffer for trend data and shall be capable of storing a sufficient number of data samples. All trend data shall be available for transfer to a Workstation without manual intervention.
    b. DDC and HVAC Mechanical Equipment Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary.

        1) Loop tuning shall be capable of being initiated either locally at the DDC and HVAC Mechanical Equipment Controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

7. DDC and HVAC Mechanical Equipment Controllers shall be capable of automatically accumulating and storing run-time hours for digital input and output points and automatically sample, calculate and store consumption totals for analog and digital pulse input type points, as specified in the point I/O schedule.
8. The peer to peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to access any data from or send control commands and alarm reports directly to any other DDC and HVAC Mechanical Equipment Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC and HVAC Mechanical Equipment Controllers shall send alarm reports to multiple workstations without dependence upon a central or intermediate processing device. The peer to peer network shall also allow any DDC and HVAC Mechanical Equipment Controller to access, edit, modify, add, delete, back up, and restore all system point database and all programs.
9. The network shall allow the DDC and HVAC Mechanical Equipment Controllers to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control the points that the operator is authorized for. All other points shall not be displayed on the PC workstation or portable terminal (e.g. all base building and all tenant points shall be accessible to any base building operators, but only tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.

M. Floor Level Network Application Specific Controllers (FEC)

1. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (FECs) through Floor Level LAN Device Networks.
2. Each FEC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each FEC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Each FEC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.

3. Terminal Equipment Controllers:

    a. Provide for control of each piece of equipment, including, but not limited to, the following:

        1) Exhaust Fans
        2) Radiant panel
        3) VAV's
        4) Unit Heaters, Cabinet Unit Heaters

    b. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, 3-15 psi pneumatic, 0-10v, allowing for interface to a variety of modulating actuators.
    c. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the FLN, BLN or MLN is not acceptable.

N. Local User Display

1. Where specified in the sequence of operation or points list, the controllers on the peer to peer building level network shall have a display and keypad for local interface. A keypad shall be provided for interrogating and commanding points in the controller.
2. The display shall use the same security password and access rights for points in the display as is used in the associated controller.
3. The LCD display shall be a minimum of a 2 line 40 character display.
4. The LCD display shall include the full point name, value (numeric, digital or state text),
5. point priority and alarm status on one screen.
6. The LCD shall dynamically update the value, priority, and alarm status for the point being displayed.
7. The display shall be mounted either on the door of the enclosure or remote from the controller.

O. Personal Computer Personal Computer Operator Workstation Hardware

1. Dedicated Web Based User Interface

    a. Where indicated on plans the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability.
    b. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

        1) Microsoft Internet Explorer for user interface functions
        2) Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
        3) Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
        4) Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries

c. PC Hardware – The personal computer(s) shall be configured as follows:

1) Memory – 16 GB
2) CPU– Pentium 4 processor. 2.8 GHz Clock Speed (2.0 GHz minimum)
3) Hard Drive – 2 TB free hard drive capacity
4) Hard drive backup system – network backup software provided by IT department
5) Ports – (2) Serial and (1) parallel, (2) USB ports
6) Keyboard – 101 Keyboard and 2 Button Mouse
7) CRT configuration – 1-2 CRTs as follows:

(a) Each Display – 24" Flat Panel Monitor 1280 x 1024 resolution minimum
(b) 16 bit or higher color resolution
(c) Display card with multiple monitor support

8) LAN communications – Ethernet communications board; 3Comm or equal

d. Operating System Software

1) Windows 11 Professional (64 bit)
2) Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
3) Provide software registration cards to the Owner for all included software.

e. Peripheral Hardware

1) Reports printer:

(a) Printer Make – Hewlett Packard DeskJet
(b) Print Speed – 600 DPI Black, 300 DPI Color
(c) Buffer – 64 K Input Print Buffer
(d) Color Printing – Include Color Kit

2. Distributed Web Based User Interface

a. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
b. The software shall run on the Microsoft Internet Explorer (12.0 or higher) browser supporting the following functions:

1) Configuration
2) Commissioning
3) Data Archiving
4) Monitoring
5) Commanding
6) System Diagnostics

3. Provide BMS operating system software for workstations with a "Windows" style Graphical User Interface (GUI). The graphics shall be accessible to users via the Operator Workstations that are hard-wired to the network or via a web browser.

4. Animated graphics shall illustrate HVAC system in pictorial format, similar to those shown on the System Schematics found in the Project Drawings. Provide a color slide depicting the Building HVAC systems. From this screen the operator shall be capable of selecting any equipment/systems located on the floor. From here, the operator shall be capable of selecting the equipment or system of interest. Provide one color slide for each system connected to the BAS. The slides shall display all major components, their status, and all variable and set points.
5. Provide a color graphic screen of each floor with terminal boxes, induction unit and fan coil units. Each floor graph shall display all boxes, radiant heating devices, fan coil units, with space temperature, space set point, CFM set point, etc.
6. Provide graphical representations of specified individual rooms (ie. Mechanical, electrical, equipment rooms, elevator machine rooms, data rooms, vivarium, etc.)
7. Provide automatic downloading of all trend data from the DDCFP's to the file server for archiving. Archiving from the file server to USB thumb device discs or other media format will be performed periodically by the owner.
8. User shall be able to adjust set points through graphics slide. All variables/set points noted in the Sequence of Operations shall be adjustable via the graphics interface.
9. Alarm conditions shall be displayed by blinking or modified color to visually distinguish the alarm state.
10. Provide status reports for each system (including system-related space sensors) which will supplement the information presented in graphical form. This will allow the operator to obtain timely, hard-copy system reports indicating the status of all system variables, many of which may not be presented in the graphic mode. System printouts shall include space sensors used for reset control. Status reports shall not be generated and printed in graphic mode.
11. Provide building energy reports.
12. To ensure security of the system, operator must access the system through an assigned password. To ensure both security and flexibility for a range of operations, the password system shall have a minimum of four levels of authorization and capacity for assignment of up to 12 different operators. The lowest level of authorization shall restrict the operator to viewing data.
13. Communications between DDC field panels and the file server shall utilize communications verification routines such as check summing or cyclical redundancy checking (CRC) to ensure proper and complete transfer of data. Systems which only repeat the message multiple times (without error checking) shall not be acceptable.
14. Software shall also perform the following functions:

    a. Initiation of logs and reports automatically on selective time, date or day basis and on combinations of time, date and day. Reports shall be in English with information formatted logically. Reports and logs shall be attainable for single points and for user-defined groups of points. Provide at least the following report categories:

        1) Summaries (all point, motor status, alarms, etc)
        2) Historical trend log
        3) Totalization logs
        4) Operation security access report
        5) Current system database
        6) Historical energy consumption logs

    b. Refer to Sequences of Operation for additional information regarding reports.
    c. Alarms and requested information shall be displayed and printed within 30 seconds of occurrence of requested regardless of amount of simultaneous system activity.
    d. Downloading programs from field panels to computer and uploading programs to the field panels from computer disk storage.
    e. Automatic recovery from a power failure without operator intervention the date and time clock must be backed up by battery for a minimum of 72 hours.

f. Software/graphics package shall permit Operators to override schedule and/or set point functions for a designated period of time via the graphics screen. A graphics screen shall be provided to indicate the current status of all systems operating in the override mode. A history provided to indicate the current status of all systems operating in the override mode. A history log shall be maintained of all override activities on the system including the Operator's initiation of the software override.

15. Provide a vented sliding rack-mount shelf for mounting of the front end operator workstation, similar to model SS2327 by "Rackmount Solutions", or equal by "Kendall Howard", "Howard Manufacturing", or Equal.

P. Workstation Operator Interface

1. Web Based Operator Interface

a. The BMS shall provide a web based graphical interface that allows users to access the BMS data via the Internet. The interface shall use HTML based ASP pages to send and receive data from the BMS to a web browser.
b. All information exchanged over Internet shall be encrypted and secure via SSL.
c. Access to the web interface will be password protected. A users rights and privileges to points and graphics will be the same as those assigned at the BMS workstation. An option will exist to only allow users "read" access via the web browser, while maintaining "command" privileges via the BMS workstation.
d. Commissioning of the Web interface shall not require modification or creation of HTML or ASP pages. All graphics available at the BMS graphical workstation shall be available to users via a web browser.
e. The web-based interface shall provide the following functionality to users, based on their access and privilege rights:

1) Logon Screen – allows the user to enter their user name, password and Domain name for logging into the web server.
2) Alarm Display – a display of current BMS alarms to which the user has access will be displayed. Users will be able to acknowledge and erase active alarms, and link to additional alarm information including alarm messages, and informational and memo text. Any alarm acknowledgements initiated through the web interface will be written to the BMS central workstation activity log.
3) Graphic Display – Display of system graphics, including animated motion, available in the BMS workstation will be available for viewing over the web browser. Software that requires creation of dedicated "web" graphics in order to display them via the browser interface will not be acceptable. A graphic selector list will allow users to select any graphics to which they have access. Graphic displays will automatically refresh with the latest change of values. Users will have the ability to command and override points from the graphic display as determined by their user accounts rights.
4) Point details – users will have access to point detail information including operational status, operational priority, physical address, and alarm limits, for point objects to which they have access rights.
5) Point Commanding – users will be able to override and command points they have access to via the web browser interface. Any commands or overrides initiated via the web browser interface will be written to the BMS central workstation activity log.

2. The web server licensing options will allow concurrent access by 10 browser connections.
3. Internet connections, ISP services, as well as necessary firewalls or proxy servers shall be provided by the Owner as required to support the web access feature.

4. Dynamic Color Graphic Displays

   a. Create color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units and hot water boiler systems, and room level terminal units, shall be provided by the BAS contractor as indicated in the point I/O schedule of this specification to optimize system performance, analysis and speed alarm recognition.
   b. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, point alarm association, or text-based commands. Graphics software shall permit the importing of Autocad or scanned pictures for use in the system.
   c. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations within the system schematics or graphic floor plan displays, and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.

      1) Provide the user the ability to display real-time point values by animated motion or custom picture control visual representation. Animation shall depict movement of mechanical equipment, or air or fluid flow. Picture Control shall depict various positions in relation to assigned point values or ranges. A library (set) of animation and picture control symbols shall be included within the workstation software's graphics application. Animation shall reflect, ON or OFF conditions, and shall also be optionally configurable for up to five rates of animation speed.
      2) Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.
      3) Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
      4) Equipment state or values can be changed by clicking on the associated point block or graphic symbol and selecting the new state (on/off) or setpoint.
      5) State text for digital points can be user-defined up to eight characters.

   d. Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.
   e. Advanced linking within the Graphics application shall provide the ability to navigate to outside documents (e.g., .doc, .pdf, .xls), internet web addresses, e-mail, external programs, and other workstation applications, directly from the Graphics application window with a mouse-click on a customizable link symbol.
   f. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
   g. Off the shelf graphic software, html web-based graphic software shall be provided to allow the user to add, modify or delete system graphic background displays.
   h. A clipart library of HVAC application and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams. The user shall have the ability to add custom symbols to the clipart library. The clipart library shall include a minimum of 400 application symbols. In addition, a library consisting of a minimum of 700 graphic background templates shall be provided.
   i. The Graphics application shall include a set of standard Terminal Equipment controller application-specific background graphic templates. Templates shall provide the automatic display of a selected Terminal Equipment controller's control values and parameters, without the need to create separate and individual graphic files for each controller.

5. System Configuration & Definition

    a. A “Collapsible tree,” dynamic system architecture diagram/display application of the site-specific BMS architecture showing status of controllers, PC workstations and networks shall be provided. This application shall include the ability to add and configure workstations, DDC Controllers or HVAC Mechanical Equipment controllers, as well as 3rd-party integrated components. Symbols/Icons representing the system architecture components shall be user-configurable and customizable, and a library of customized icons representing 3rd-party integration solutions shall be included. This application shall also include the functionality for real-time display, configuration and diagnostics of dial-up modems to DDC Controllers.
    b. Network wide control strategies shall not be restricted to a single DDC Controller or HVAC Mechanical Equipment controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.
    c. Provide automatic backup and restore of all DDC controller and HVAC Mechanical Equipment controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller or HVAC Mechanical Equipment Controller. Changes made at the user-interface of DDC Controllers or HVAC Mechanical Equipment Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
    d. System configuration, programming, editing, graphics generation shall be performed on-line. If programming and system back-up must be done with the PC workstation off-line, the BMS contractor shall provide at least 2 operator workstations.
    e. Point database configuration shall be available to the user within a dedicated point database editor application included in the workstation software. The editor shall allow the user to create, view existing, modify, copy, and delete points from the database. The point editor shall also allow the user to configure the alarm management strategy for each point. The editor shall provide the option for editing the point database in an online or offline mode with the DDC Controllers.

        1) The workstation software shall also provide the capability to perform bulk modification of point definition attributes to a single or multiple user-selected points. This function shall allow the user to choose the properties to copy from a selected point to another point or set of points. The selectable attributes shall include, but are not limited to, Alarm management definitions and Trend definitions.

6. Alarm Management

    a. Alarm Routing shall allow the user to send alarm notification to selected printers or workstation location(s) based on time of day, alarm severity, or point type.
    b. Alarm Notification shall be presented to each workstation in a tabular format application, and shall include the following information for each alarm point: name, value, alarm time and date, alarm status, priority, acknowledgement information, and alarm count. Each alarm point or priority shall have the ability to sound a discrete audible notification.
    c. Alarm Display shall have the ability to list and sort the alarms based on alarm status, point name, ascending or descending alarm time.
    d. Directly from the Alarm Display, the user shall have the ability to acknowledge, silence the alarm sound, print, or erase each alarm. The interface shall also have the option to inhibit the erasing of active acknowledged alarms, until they have returned to normal status. The user shall also have the ability to command, launch an associated graphic or trended graphical plot, or run a report on a selected alarm point directly on the Alarm Display.

e. Each alarm point shall have a direct link from the Alarm Display to further user-defined point informational data. The user shall have the ability to also associate real-time electronic annotations or notes to each alarm.
f. Alarm messages shall be customizable for each point, or each alarm priority level, to display detailed instructions to the user regarding actions to take in the event of an alarm. Alarm messages shall also have the optional ability to individually enunciate on the workstation display via a separate pop-up window, automatically being generated as the associated alarm condition occurs.
g. Alarm Display application shall allow workstation operators to send and receive real-time messages to each other, for purposes of coordinating Alarm and BAS system management.
h. Remote notification of messages

1) Workstation shall be configured to send out messages to numeric pagers, alphanumeric pagers, phones (via text to speech technology), SMS (Simple Messaging Service, text messaging) Devices, and email accounts based on a point's alarm condition.
2) There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices which can receive messages from the system.
3) On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.
4) Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.
5) System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.
6) Message detail shall be configurable on a per user basis.
7) During a "flood" of alarms, remote notification messages shall have the ability to optimize several alarms into an individual remote notification message.
8) Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.
9) Workstation shall have a feature to send a heartbeat message to periodically notify users that they have communication with the system.

7. Front End user interface:

a. ATC contractor to provide documents on the front end for the owner/facilities to reference. On the main screen there shall be a "Facilities Tools" link that will direct the user to a page with trade sub-menus. These sub menus shall include HVAC, Plumbing, Fire Protection, Electrical, and Fire alarm. Each trade shall have the files organized under these categories:

1) As-Builts
2) TAB Reports
3) Equipment submittals
4) Equipment O&M's
5) Approved submittals
6) Training Videos/documents

b. The reference documents shall be accessible from this page via hyperlink. The hyperlinks shall directly open the files which will be saved locally on the server.
c. All approved job documents shall be included in these sub-menus. Owners' representative is responsible for providing the ATC contractor the proper documentation to be included in this database.
d. All documents shall be organized logically for easy navigation.

Q. Field Devices

1. Provide instrumentation as required for monitoring, control or optimization functions.
2. Room Temperature Sensors

   a. All temperature sensors shall be BACnet IP network type. Office areas shall be provided with digital combination room sensors for temperature, humidity and CO2 and shall have LCD display, day / night override button, and setpoint slide adjustment. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment. Public areas such as corridors, entry areas, vestibules, restrooms shall have chrome cover plate temperature sensors without adjustment or occupied/unoccupied capability.

Temperature monitoring range	+20/120 deg. F -13 deg. to 49 deg. C)
Output signal	Changing resistance
Accuracy at Calibration point	+0.5 deg. F (+/- 0.3 deg. C)
Set Point and Display Range	55 deg. to 95 deg. F (13 deg. to 35 deg. C)

3. Liquid immersion temperature:

a.	Temperature monitoring range	+30/250 deg. F (-1 deg. /121 deg. C)
b.	Output signal	Changing resistance
c.	Accuracy at Calibration point	+0.5 deg. F (+/-0.3 deg. C)

4. Duct (single point) temperature:

a.	Temperature monitoring range	+20/120 deg. F (-7 deg. /49 deg. C)
a.	Output signal	Changing resistance
b.	Accuracy at Calibration point	+0.5 deg. F (+/-0.3 deg. C)

5. Duct Average temperature:

a.	Temperature monitoring range	+20 deg.+120 deg.F(-7 deg./+49 deg. C)
c.	Output signal	4 – 20 mA DC
d.	Accuracy at Calibration point	+0.5 deg. F (+03 deg. C)
e.	Sensor Probe Length	25 ft. L (7.3m)

6. Outside air temperature:

a.	Temperature monitoring range	-58deg.+122deg.F(-50deg.Cto 50deg.C)
b.	Output signal	4 – 20 mA DC
c.	Accuracy at Calibration point	+0.5 deg. F (+/-0.3 deg. C)

7. Liquid Differential Pressure Transmitter

a.	Ranges	0-5/30 in. H20 0-25/150 in. H20 0-125/750 in. H20
b.	Output	4 – 20 mA DC
c.	Calibration Adjustments Zero and span	
d.	Accuracy	+-0.2 percent of span
e.	Linearity	+-0.1 percent of span
f.	Hysteresis	+-0.05 percent of span

8. Differential pressure:

a.	Unit for fluid flow proof shall be Penn P74.	
b.	Range	8 to 70 psi
c.	Differential	3 psi
d.	Maximum differential pressure	200 psi
e.	Maximum pressure	325 psi
f.	Unit for air flow settings.	
g.	Set point ranges:	0.5 in. WG to 1.0 in. W (124.4 to 248.8 Pa) 1.0 in. WG to 12.0 in. WG (248.8 to 497.6 Pa)

9. Static pressure sensor:

a.	Range	0 to .5 in.WG (0 to 124.4 Pa) 0 to 1 in.WG (0 to 248.8 Pa) 0 to 2 in. WG (0 to 497.7 Pa) 0 to 5” in.WG (0 to 1.2 kPa 0 to 10” WG (0 to 2.5 kPa)
b.	Output Signal	4 – 20 mA VDC
c.	Combined static error	0.5 percent full range
d.	Operating Temperature	-40 deg. to 175 deg. F (-40 deg. C to 79.5 deg. C)

10. Air Pressure Sensor:

a.	Range:	0 to 0.1 in. water (0 to 24.9 Pa) 0 to 0.25 in. water (0 to 63.2 Pa) 0 to 0.5 in. water (0 to 124.5 Pa) 0 to 1.0 in. water (o to 249 Pa) 0 to 2.0 in water 90 to 498 Pa) 0 to 5.0 in. water (0 to 1.25 kPa) 0 to 10.0 in. water (0 to 2.49 kPa)
b.	Output signal	4 to 20 mA
c.	Accuracy	+1.0 percent of full scale

11. Humidity Sensors: All room/zone humidity sensors shall be BACnet compatible network type.

a.	Range	0 to 100 percent RH
b.	Sensing Element	Bulk Polymer
c.	Output Signal	4 – 20 mA DC
d.	Accuracy	At 77 deg. F (25 deg. C) + 2 percent RH
		Humidistat:
e.	Range	0 to 100 percent RH
f.	Sensing Element	Bulk Polymer
g.	Output Signal	4 – 20 mA DC
h.	Accuracy	At 77 deg. F(25 deg. C) + 2 percent RH

12. Insertion Flow Meters (Equal to Onicon F-5300)

a.	Sensing Method	Impedance Sensing
b.	Accuracy	+ 2 percent of Actual Reading
c.	Maximum Operating Pressure	400 PSI
d.	Output Signal	4 – 20 mA
e.	Bi-directional where required.	

13. Pressure to Current Transducer

a.	Range	3 to 15 psig (21 to 103 kPa) or 3 to 30 psig (21 to 207 kPa)
b.	Output signal	4 – 20 mA
c.	Accuracy	+ 1 percent of full scale (+ 0.3 psig)

14. Carbon Dioxide Sensor : All room/zone CO2 & duct mounted sensors shall be BACnet compatible network type and shall have a minimum 5 year calibration period.

a.	Range	0 to 1500 ppm
b.	Accuracy	20+ ppm

c. CO2 sensors located in gymnasiums and locker rooms shall be provided with tamper proof guard.

15. Control Valves (all control valves shall have electric actuators with position feedback to provide confirmation of valve position).

a. Electric Control

1)	Rangeability	40:1
2)	Flow Characteristics	Modified. Equal percentage
3)	Control Action	Normal open for hot water and normal closed for cooling
4)	Medium	Steam, water, glycol
5)	Body Type	Screwed ends 2 in. and smaller, flanged Valves 2½ in. and larger
6)	Body Material	Bronze
7)	Body Trim	Bronze
8)	Stem	Stainless Steel
9)	Actuator	0-10 VDC, 4-20 MA or 2 position 24 VAC/120VAC – Modulating for all hot water and chilled water valves with a GPM value of 1 or above, 2 position valves for all GPM's under 1.

b. All automatic temperature control valves in water lines shall be provided with Characterized throttling plugs and shall be sized for minimum 25 percent of the system pressure drop or three psi, whichever is less.

1) Positive positioning relays shall be provided on pneumatic control when required to provide sufficient power for sequencing.
2) Two position valves shall be line size.

16. Damper Actuators

a. Electric control shall be direct coupled actuators with position feedback to BMS.
b. Damper actuators shall be Brushless DC Motor Technology with stall protection, bi-directional, fail safe spring return, all metal housing, manual override, independently adjustable dual auxiliary switch.

1) The actuator assembly shall include the necessary hardware and proper mounting and connection to a standard ½ in. diameter shaft or damper blade.

c. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.
d. All actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator's output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed

"v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with the damper shaft.

e. All actuators having more than a 100 lb-in torque output shall accept a 1 in. diameter shaft directly, without the need for auxiliary adapters.

f. All actuators shall be designed and manufactured by Belimo or approved equal using ISO900 registered procedures, and shall be Listed under Standards UL873 and CSA22.2 No. 24-93 l.

R. Meters: Provide the following meters (or connection to meters) and network these devices into the Building Management System.

1. Provide all necessary components and accessories required for connection to main electrical KYZ pulse consumption meters (kWh). Meters shall be provided by Division 26 00 10. Refer to Electrical Drawings for meter location.

S. Miscellaneous Devices

1. Freezestats:

a. Install freezestats on each coil that mixes outside and return air (air handling units, fan coils, unit ventilators) and provide protection for every square foot of coil surface area with one linear foot of element per square foot of coil.

1) Upon detection of low temperature, the freezestats shall stop the associated supply fans and return the automatic dampers to their normal position close outside air dampers and open coil valve for full flow. Provide manual reset.

2. Firestats:

a. Provide manual reset, fixed temperature line voltage type with a bi-metal actuated switch.

1) Switch shall have adequate rating for required load.

3. Electronic Airflow Measurement Stations and Transmitters (Where indicated on Control Drawings).

a. Provide air flow moving stations as shown on drawings.

b. Stations – each insertion station shall contain an array of velocity sensing elements and straightening vanes. The velocity sensing elements shall be of the RTD or thermistor type. The sensing elements shall be distributed across the duct cross section in a quality to provide accurate readings. The resistance to airflow through the airflow measurement station shall not exceed 0.08 in. water gage at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflow of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 125 to 2,500 fpm scaled to air volume. Each transmitter shall produce a linear, temperature compensated 4 to 40 mA DC, output corresponding to the required velocity pressure measurement. Provide local readout on unit.

c. Fan inlet airflow sensing

1) Where mounted into controllable pitch axial inlet bells, or inlet cones of centrifugal fans, the traverse probe assemblies shall be complete with all necessary end mounting plates and master takeoff fittings. All mounting bolts, lock washers and nuts; interconnecting tubing and compression fittings to be provided by the installing contractor.
2) Primary flow elements shall not be used on fan inlet applications where the narrowest diameter of the inlet cone is under ten in. without prior approval. Fan inlet sensors shall not be used on fans having inlet guide vanes. The use of only one static element and one total pressure element on fan inlets is prohibited. Fan primary elements shall not exceed .562 in. in diameter on fans having inlet cone diameters less than 30 in..
3) Fan inlet airflow sensing similar to Ebtron GTx116F or Paragon Controls model FE-1050.

d. Electronic Transducers

1) Provide individual differential static pressure and airflow transducers, selected for the required range of each of the above primary elements, and in accordance with the following:
2) The transducer(s) shall be solid-state electronic type, with infinite output resolution, capable of performing dedicated static pressure and air volume control functions. Microprocessor based transducers with time-sharing of multiple square root extractors and/or controllers are not acceptable.
3) Each transducer's output shall not be affected by direction of mounting (attitude) or external vibrations, and shall be furnished with a factory-calibrated range that matches the application.
4) Airflow transducers shall be provided with an integral dual scale indicating meter operating independent of all other control devices. The top scale shall indicate the measured air volume in units of cubic ft. per minute (CFM), and the bottom scale shall indicate the air velocity in units of ft. per minute (FPM).

   (a) The meter shall be a differential pressure type that is diaphragm actuated, and is to be flush mounted on the enclosure door.
   (b) The meter shall be calibrated to an accuracy of +2 percent of span.

5) Transducer performance shall be equal to or better than the following:

   (a) Accuracy: +/- 0.5 percent F.S. (Terminal Point) / +/- 0.35 percent F.S. (BFSL)
   (b) Temperature Effects: <0.03 percent F.S./deg F
   (c) Over-pressure: 5 PSIG Proof / 10 PSIG Burst
   (d) Response: <0.25 seconds for full scale input
   (e) Noise Filtration: Low Pass Filter, factory set @ 3.2Hz

6) Each transducer shall be selected for its respective duty. Supply, Exhaust and/or Return Airflow Transducers shall provide analog output signal linear to air volume that are factory set for a full scale value equal to 110 percent of the maximum design capacity of the flow measuring element served for variable air volume applications, or 200 percent of the design operating value for constant volume applications.
7) Airflow transducers for operating velocities below 1266 ft. per minute shall provide the following features:

   (a) Local electronic indication of the measure airflow rate.
   (b) The indicating meter shall be one-half in. high, three and one half digit light emitting diode (LED) type.

(c) The LED shall indicate the measured air volume in engineering units of cubic ft. per minute (CFM).
(d) Automatic zeroing circuit that shall maintain the transducer output to within 0.1 percent of value, and shall be field configurable for frequency of activation between one and seventy two hours.
(e) The transducer output shall be locked and maintained at the last given output value during the automatic zeroing period so as not to interrupt the automatic control process.
(f) The meter shall be auto calibrated to an accuracy of +/- 1 count.
(g) Transducer accuracy shall be +/- 0.25 percent F.S. (Terminal Point) / +/- 0.15 percent F.S. (BFSL)

4. Current Sensing Relay:

a. Provide solid-state, adjustable, current operated relay. Provide a relay which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.
b. Adjust the relay switch point so that the relay responds to motor operation under load as an “on” state and so that the relay responds to an unloaded running motor as an “off” state. A motor with a broken belt is considered an unloaded motor.
c. Provide for status device for all fans and pumps.

5. Refrigerant Monitoring System

a. The refrigerant gas monitor shall be a single zone type, designed for continuous monitoring of CFC, HFC, HCFC levels; specifically R-410A for this application, confirm and verify with VRF manufacturer. The refrigerant gas detector shall have two adjustable alarm levels with relay outputs to designate leak and evacuation concentrations. The gas detector and monitor shall provide a system fault relay output and a 4-20 mA output for integration with remote monitoring equipment or a building automation system.
b. A sensor with alarm strobe/horn combination shall be mounted inside each dorm room. Upon a refrigerant alarm condition, these alarms will show a red strobe light and audible alarm notifying building occupants of the alarm. Audible alarm may be enabled/disabled via dip switch or BMS command.
c. Refrigerant gas monitoring:

1) A refrigerant gas monitoring system as specified herein shall be installed by the ATC contractor to monitor any refrigerant gas leaks at all times.
2) If the refrigerant gas monitor shall detect a leak, via the BMS, an alarm shall be sent to the Owners central operator work-station and the BMS shall disable the VRF system.
3) Upon any refrigerant alarm condition, both combination strobe lights/horns shall annunciate notifying building occupants of the alarm condition.
4) The equipment that has been shut down shall remain off until the cause of the leak has been determined by the Owners personnel, is remedied and/or it is deemed by the Owner to be safe to return to normal operations.
5) The basis of design refrigerant detection system is based on “Bacharch” Model MVR-300 space sensors.

T. Manufacturers: Subject to compliance with requirements, provide an automatic temperature control system of one of the following:

1. Johnson Controls
2. Honeywell
3. Sneider Electric
4. Delta Controls
5. Or equal

PART 3 - EXECUTION

3.1 ATTIC STOCK

A. Rooftop Units

1. Four additional complete extra sets of pre and final filters for each RTU/ ERV/ HV/ AHU for attic stock. All these filters indicated above including the four sets of attic stock are additional to those provided for flush out and indoor air quality requirements per LEED requirements.
2. Provide one spare set of belts for each belt-driven air handling unit.
3. Obtain receipt from Owner that attic stock provided.

B. Power and Gravity Ventilators

1. Furnish to Owner, with receipt, one spare set of belts for each belt driven power ventilator

C. Ductwork Accessories

1. Furnish extra fusible links to owner, one link for every 10 installed of each temperature range; obtain receipt.

D. Unit Heaters

1. Furnish to Owner, with receipt, (2) spare sets of filters per each unit.

E. Ductless Cooling Units

1. Furnish to Owner, with receipt, (2) spare sets of filters per each indoor unit.

F. Condensate Discharge Pumps

1. Furnish to Owner, with receipt, (10) new condensate pumps to attic stock.

G. Variable Refrigerant Flow (VRF) System

1. Furnish to Owner, with receipt, (2) spare sets of filters per each indoor unit.

H. Duct Mounted Filter Boxes

1. HVAC contractor shall provide six (6) spare 4” MERV-13 Filters to owner for Attic Stock.

I. Obtain signed receipts showing delivery of the following items to the owner. Submit copies of signed receipts prior to request for substantial completion.

3.2 INSTALLATION OF VALVES

A. Examine valve interior through the end ports, for cleanliness, freedom from foreign matter and corrosion. Remove special packing materials, such as blocks used which prevents disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the position in which it was shipped.

C. Examine threads on both the valve and the mating pipe for form (out-of-round or local indentation) and cleanliness.

D. Examine mating flange faces for conditions which might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size and material, and for freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

F. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

1. Copper Tube 2" and smaller Solder ends.

G. Valve Installation:

1. Locate valves for easy access and provide separate support where necessary.
2. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.
3. Install valves in horizontal piping with the stem at or above the center of the pipe.
4. Installation of Check Valves: Install for proper direction of flow as follows:

a. Swing Check Valves: Install in horizontal position with hinge pin level.
b. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position.
c. Lift Check Valves: Install in piping line with stem upright and plumb.

H. Threaded Connections:

1. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

I. Field Quality Control:

1. Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

J. Adjusting and Cleaning:

1. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive painting or insulation.

3.3 INSTALLATION OF METERS AND GAUGES

A. Installation of Temperature Gauges:

1. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor.
2. Temperature Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure Cap.

B. Installation of Pressure Gauges:

1. General: Install pressure gauges in piping tee with pressure gauge located on pipe at most readable position.
2. Pressure Gauge Cocks: Install in piping tee with snubber. Install siphon for steam pressure gauges.

C. Installation of Flow Measuring Fittings:

1. General: Install flow measure fittings in piping systems located in accessible locations.

D. Adjusting and Cleaning:

1. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.
2. Cleaning: Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

3.4 INSTALLATION OF HANGERS & ATTACHMENTS

A. Vibration Control and Seismic Restraint: Refer to section 23 05 48 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 23 05 48 and drawing VS-1.

B. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

C. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors, and other building structural attachments.

D. Prior to installation of hangers, supports, anchors, and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purposes of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

E. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through the openings at the tops of inserts.

F. Install hangers, supports, clamps, and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

2. Prevent electrolysis in support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.
3. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
4. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
5. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
6. Insulated Piping: Comply with the following installation requirements:

    a. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
    b. Shields: For pipe sizes up to and including 4” provide heavy gauge shield at each hanger point.
    c. Saddles: For all pipe sizes over 4” provide saddle at each hanger point. Completely fill void in saddle with loose insulation.

G. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer for loading and stresses to connected equipment.

H. Fabricate and install anchor by welding steel shapes, plates, and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

I. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

J. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

K. Provide concrete housekeeping bases for all floor-mounted equipment. Size bases to extend minimum of 4" beyond equipment base in any direction; and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

L. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

M. Adjusting and Cleaning:

1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
3. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 INSTALLATION OF MECHANICAL IDENTIFICATION

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated. Install on pipe insulation segment where required for hot non-insulated pipes.

C. Locate pipe markers and color bands as follows wherever piping is in or above occupied spaces or corridors, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings.

D. Valve Identification:

1. General: Provide valve tag on every valve, cock, and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
2. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

E. Mechanical Equipment Identification:

1. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device.
2. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2' - 0", 1\2" high for distances up to 6' - 0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

F. Adjusting and Cleaning:

1. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
2. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.6 INSTALLATION OF MECHANICAL INSULATION

A. Installation of Piping Insulation:

1. Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; on heating piping beyond control valve, located within heated space; on condensate piping between steam trap and union; and on unions, flanges, strainers, flexible connections, and expansion joints. (Couplings in mechanical grooved systems will be insulated.)
2. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
3. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance tests.
4. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
5. Clean and dry pipe surfaces prior to insulating. Butt installation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
6. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
7. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
8. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
9. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

B. Installation of Ductwork Insulation:

1. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its indented purpose.
2. Install insulation materials with smooth and even surfaces.
3. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
4. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
5. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
6. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

C. Protection and Replacement:

1. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
2. Protection; Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

D. Refrigerant Piping Insulation Specific Installation requirements:

1. Insulation must be adhered to piping every 18’-0” of piping length at a minimum.
2. Insulation must be sealed to a flat surface at every end of a pipe run, or an end cap should be used if adhering to a flat surface is not possible.

3. Pipe supports shall never clamp directly to flexible insulation; saddles and shields shall be placed beneath piping at support locations to prevent insulation damage as piping moves from expansion and contraction.
4. Insulation shall never be stretched over a 90 degree fitting; pre-insulated fittings from the insulation manufacturer shall be used.
5. Piping to receive insulation must be clean, dry, and non-operational at the time of insulation installation.

3.7 INSTALLATION OF REFRIGERANT PIPING AND ACCESSORIES

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS-1.

B. Piping Installations:

1. Locations and Arrangements: Drawings indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design consideration. So far as practical, install piping as indicated.
2. Install piping at a uniform grade of 1 in. in 40 ft. upward in the direction of flow.
3. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.
4. Install branch connections to mains using Tee fittings in main with take-off out the bottom, except for up-freed risers which shall have take-off out the top of the main line.
5. Install unions in pipes 2 in. and smaller, adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
6. Install flanges on valves, apparatus, and equipment having 2-1/2 in. and larger connections.
7. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2 in. and larger.
8. Anchor piping to ensure proper direction of expansion and contraction. Expansion loops and joints are indicated on the Drawings.
9. Install pipe sleeves at all wall and floor penetrations.
10. Install escutcheons at all exposed pipe wall penetrations.
11. Provide Dielectric couplings at all dissimilar piping/valve connections.

C. Pipe Applications:

1. Copper Tubing: Use Type L, drawn copper tubing with wrought copper fittings and solder joints for 2 in. and smaller, above ground, within building. Use Type K, annealed temper copper tubing for 2 in. and smaller without joints, below ground or within slabs. Mechanical fittings (crimp or flair) are not permitted.
2. Steel Pipe: Use steel pipe with threaded joints and fittings for 2 in. and smaller, and with welded joints for 2-1/2 in. and larger.
3. Steel Pipe: Use mechanical grooved end steel pipe and mechanical couplings and fittings.

D. Valve Applications:

1. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:

   a. Shut-Off Duty: Use gate, and ball, valves.

2. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

E. Field Quality Control:

1. Preparation for Testing: Prepare hydronic piping in accordance with ASME B 31.9 and as follows:

   a. Leave joints including welds uninsulated and exposed for examination during the test.
   b. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
   c. Flush system with clean water. Clean strainers.
   d. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
   e. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

2. Testing: Test hydronic piping as follows:

   a. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
   b. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at point for complete removal of the liquid.
   c. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
   d. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, Building Services Piping.
   e. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connection for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

F. Adjusting and Cleaning:

1. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
2. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.

3.8 INSTALLATION OF ROOFTOP UNITS WITH ENERGY RECOVERY

A. Vibration Control and Seismic Restraint: Refer to section 23 05 48 and drawing VS-1 or the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 23 05 48 and drawing VS-1.

B. General: Install rooftop energy recovery units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

C. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air-handling units with other work.

D. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

F. Duct Connections: Provide ductwork, accessories, and flexible connections as indicated.

G. Grounding: Provide positive equipment ground for air-handling unit components.

H. Testing: Upon completion of installation of energy recover units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, than retest to demonstrate compliance.

I. Field Quality Control

1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

J. Startup Services

1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein; at a minimum perform the following:

    a. Operational Test: After electrical circuitry has been energized and crankcase heaters have had sufficient on-time, start units to confirm proper motor rotation and unit operation.
    b. Enter or adjust all controller set-points as required to meet specific project requirements.
    c. Set initial temperature and humidity set points.
    d. Set field-adjustable switches as indicated.

K. Demonstration and Training

1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

L. Provide two complete extra sets of filters for each air handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

M. Provide one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

3.9 INSTALLATION OF ROOFTOP MAKE-UP AIR UNIT

A. Vibration Control and Seismic Restraint: Refer to section 23 05 48 and drawing VS.1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 23 05 48 and drawing VS.1.

B. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in location indicated, and maintain manufacturer's recommended clearances.

C. Support: The roofing contractor shall install and secure roof curb to roof structure, per details on the drawings and in accordance with National Roofing Contractors Association (NRCA) installation recommendations and shop drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.

D. Electrical Connections: Refer to electrical sections for final connections to equipment and installation of loose shipped electrical components.

E. Start-Up Services:

1. Provide the services of a factory-authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

F. Operating and Maintenance Training:

1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of rooftop units. Training shall include start-up and shut-down, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance.
2. Schedule training with Owner, provide at least 7-day prior notice to the Architect/Engineer.

3.10 INSTALLATION OF ROOFTOP ENERGY RECOVERY VENTILATOR

A. INSTALLATION

1. Install equipment in accordance with manufacturer instructions, these specifications, best practices, and all applicable building codes.

B. START UP SERVICE

1. Engage factory authorized service technician to start up and commission units. Provide start up report to owner.

3.11 INSTALLATION OF TERMINAL HEATING UNITS (ELECTRIC)

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS-1.

B. Installation of Finned Tube Radiation: (Electric)

1. General: Install finned tube radiation as indicated, and in accordance with manufacturer's installation instructions.
2. Locate finned tube radiation as indicated, run cover wall-to-wall unless otherwise indicated. Provide butt caps, splice joints, "Z" bends etc. for a complete installation.
3. Install access panels centered in front of each shutoff valve, balancing cock, steam trap, or temperature control valve.

C. Installation of Horizontal Unit Heaters: (Electric)

1. General: Install unit heaters as indicated, and in accordance with manufacturer's installation instructions.
2. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.
3. Hang units from building substrate, not from piping. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.
4. Support units with rod-type hangers anchored to building substrate.
5. Install piping as indicated.
6. Protect units with protective covers during balance of construction.

D. Installation of Radiant Panels & Radiation Wall Units:

1. Install components level and plumb. Maintain sufficient clearance for normal services, maintenance, or in accordance with construction drawings.
2. Complete installation and startup checks according to manufacturer’s written instructions and perform the following:

    a. Verify that controls and control enclosure are accessible.
    b. Verify that control connections are complete to control valves as needed.
    c. Verify that any identification tags are visible.
    d. Verify that controls respond to inputs as specified.

3. Connections

    a. Piping installation requirements are specified in other Division 23 Sections. Drawings indicated general arrangement of piping, fittings, and specialties.
    b. Install piping adjacent to radiant panels to allow for service and maintenance.
    c. In addition to Division 23 Section “Hydronic Piping”, connect copper tubing to supply with shut-off valve, strainer, control valve, and union or flange, and return pipe with balancing valve and union or flange.

4. Field Quality Control

    a. Perform the following field tests and inspections and prepare test reports:

        1) Leak Test: After installation, fill water tubes and test for leaks. Repair leaks and retest until no leaks exist.
        2) Operational Test: After electrical circuitry has been energized, start units to conform to proper unit operation.

3) Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

b. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field assembled components and equipment installation, including connections, and to assist in field testing. Report any findings in writing.
c. Remove and replace malfunctioning units and retest as specified above.

5. Cleaning and Protection

a. Clean all visible surfaces of equipment; touch up as required.
b. Protect all units before, during and after installation. Damaged materials due to improper protection shall be cause for rejection.

6. Construction Phase Services

a. Manufacturer or factory-authorized representative shall visit the site regularly during the installation process to ensure proper means and methods are being employed. Bid shall include the cost of a minimum of two (2) such visits.
b. Manufacturer or factory-authorized representative shall provide start-up and training services to owners/staff to adjust, operate, and maintain radiant panels.

E. Installation of Cabinet Unit Heaters (Electrical):

1. General: Install cabinet heaters as indicated, and in accordance with manufacturer's installation instructions.
2. Coordinate with other trades to assure correct recess size for recessed units.
3. Protect units with protective covers during balance of construction.

F. Installation of Fan-Coil Units: (Electrical/Vertical Upright)

1. General: Install fan-coil units as indicated, and in accordance with manufacturer's installation instructions.
2. Coordinate with other trades to assure correct recess size for recessed units.
3. Install piping as indicated.
4. Protect units with protective covers during balance of construction.

G. Adjusting and Cleaning:

1. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
2. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
3. Install new filter units for terminals requiring same.

3.12 INSTALLATION OF ELECTRIC DUCT COILS

A. Installation

1. Locate, orient, and connect ductwork per AMCA, ASHRAE, and SMACNA guidelines. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.
2. Provide a structurally suitable support as necessary for all units. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
3. Perform all work required to provide and install the following electric duct heaters indicated by the contract documents with supplementary items necessary for proper installation.

4. All installation shall be in accordance with manufacturer's published recommendations.
5. Inspect areas and conditions under which heater units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.
6. Do not operate electric heaters for any purpose until ductwork is clean of any possible debris.
7. Maintain minimum working clearances around the heater electrical panel in accordance with NEC Article 110.
8. Install duct heaters in metal ducts and casings constructed according to SMACNA "HVAC Duct Construction Standards."
9. If applicable, anchor duct heaters in position using suitable supports.
10. Connect duct heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.
11. After construction is completed, including painting, clean unit's exposed surfaces and vacuum clean electric duct heaters and inside of cabinets.
12. Touch up scratches and marks from handling and placement of equipment with masking enamel to match manufacturer's color. Refer to Division 09 for site-applied finishes.

B. Delivery, Storage, and Handling

1. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 23 requirements.
2. Accept products at the Project Site in factory-fabricated protective containers or coverings, with factory-installed shipping skids. Inspect for damage.
3. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
4. Check and maintain equipment on a monthly basis to ensure that equipment is being stored in accordance with manufacturer's recommended practices. Storage records shall be maintained that indicate these requirements have been met.

3.13 INSTALLATION OF DX HEATING/COOLING COIL

A. Vibration Control and Seismic Restraint: Refer to SECTION 23 05 48 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in SECTION 23 05 48 and drawing VS-1.

B. General:

1. Verify all dimensions by field measurements. Verify roof structure, mounting supports, wall structure, and membrane installations are completed to the proper point to allow installation of wall mounted and roof mounted units. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation. Do not proceed until unsatisfactory conditions have been corrected.
2. Install equipment in accordance with manufacturer’s installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

C. Field Quality Control:

1. Provide the services, to include a written report, of a factory authorized service representative to examine the field assembly of the components, installation, and piping and electrical connections.
2. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

D. Demonstration:

1. Provide the services of a factory authorized service representative to provide start-up service and to demonstrate and train the Owner's maintenance personnel as specified below.
2. Start-up service: Place units into operation and adjust controls and safeties. Replace damaged or malfunctioning components and controls.

E. Training:

1. Train the Owner's maintenance personnel on start-up and shut-down procedures, troubleshooting procedures, and servicing and preventative maintenance schedules and procedures.
2. Schedule training with Owner through the Architect/Engineer with at least 7 days prior notice.

3.14 INSTALLATION OF DUCTLESS COOLING UNIT SYSTEMS

A. Vibration Control and Seismic Restraint: Refer to section 23 05 48 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 23 05 48 and drawing VS-1.

B. General:

1. Verify all dimensions by field measurements. Verify roof structure, mounting supports, wall structure, and membrane installations are completed to the proper point to allow installation of wall mounted and roof mounted units. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation. Do not proceed until unsatisfactory conditions have been corrected.
2. Install equipment in accordance with manufacturer’s installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

C. Field Quality Control:

1. Provide the services, to include a written report, of a factory authorized service representative to examine the field assembly of the components, installation, and piping and electrical connections.
2. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

D. Demonstration:

1. Provide the services of a factory authorized service representative to provide start-up service and to demonstrate and train the Owner's maintenance personnel as specified below.
2. Start-up service: Place units into operation and adjust controls and safeties. Replace Damaged Or Malfunctioning Components And Controls.

E. Training:

1. Train the Owner's maintenance personnel on start-up and shut-down procedures, troubleshooting procedures, and servicing and preventative maintenance schedules and procedures.
2. Schedule training with Owner through the Architect/Engineer with at least seven days prior notice.

3.15 INSTALLATION OF POWER AND GRAVITY VENTILATORS

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS-1.

B. General: Except as otherwise indicated or specified, install ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that products serve the intended function.

C. Coordinate ventilator work with work of roofing, walls and ceilings, as necessary for proper interfacing.

D. Ductwork: Connect ducts to ventilators in accordance with manufacturer's installation instruction, and details on drawings.

E. Roof Curbs: Furnish roof curbs to roofing Installer for installation.

F. Motorized dampers are required at all ducted Outdoor Air and exhaust roof hoods and Louvers.

G. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

H. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

I. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of unit at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

J. Cleaning: Clean factory-finished surface. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

K. General: Furnish to Owner, with receipt, one spare set of belts for each belt driven power ventilator.

3.16 INSTALLATION OF METAL DUCTWORK

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS-1.

B. Installation of Metal Ductwork:

1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately with internal surface smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.
2. Sealing: All ductwork joints and seams shall be sealed with flexible duct sealer to assure an airtight installation.
3. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

    a. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate.

4. Coordination: Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
5. Installation: Install metal ductwork in accordance with "SMACNA HVAC Duct Construction Standards".

C. Installation of Duct Liners:

1. General: Install duct liners in accordance with SMACNA "HVAC Duct Construction Standards".

D. Installation of Flexible Ducts:

1. Maximum Length: For any duct run using flexible ductwork, do not exceed 4'-0" extended length.
2. Installation: Install in accordance with Section II of SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible".

E. Installation of Kitchen Exhaust Ducts:

1. General: All ductwork, per IMC section 505 should be constructed of stainless steel sheet metal, have smooth interior walls. Install without dips or traps which may collect residues. Provide access openings at each change in direction, locate on sides of duct 1-1/2" minimum from bottom, and fitted with grease-tight covers of same material as duct.
2. Kitchen exhaust hood ductwork shall be fabricated and installed in full accordance with the requirements of IMC Section 505. Duct shall be properly attached to exhaust hoods and fans. Required clean-out access doors shall be installed in the vertical face of the ductwork. Only opposed blade dampers may be used in kitchen make-up air duct work requiring balancing.

F. Field Quality Control:

1. Leakage Tests: After each duct system, which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA "HVAC Air Duct Leakage Test Manual". Repair leaks and repeat tests until total leakage is less than 1% of system design air flow.

G. Equipment Connections:

1. General: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery.

H. Adjusting and Cleaning:

1. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
2. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.
3. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until final connections are to be completed.
4. Balancing: Refer to Division 23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork. Seal any leaks in ductwork that become apparent in balancing process.

3.17 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 degree elbows in supply, return, and exhaust air systems, and elsewhere as indicated.

C. Install splitter damper with adjusting rod in each supply branch. Install according to detail on drawings.

D. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

E. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

F. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

G. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

H. Furnish extra fusible links to owner, one link for every 10 installed of each temperature range; obtain receipt.

3.18 INSTALLATION OF ACOUSTIC DUCT LINING

A. Installation: All portions of duct designed to receive duct liner shall be completely covered. The smooth, black coated surfaces shall face the airstream. All liners shall be cut to assure tight, overlapped corner joints. The top pieces shall be supported by the side pieces. The liner shall be adhered to the sheet metal with full coverage of an approved adhesive that conforms to ASTM C 916, and all exposed leading edges and transverse joints shall be coated with Permacote factory-applied or field-applied edge coating and shall be neatly butted without gaps. Shop or field cuts shall be liberally coated with "Schuller SuperSeal Edge Treatment" or approved adhesive. The liner shall be additionally secured with mechanical fasteners. The pin length should be such as to hold the material firmly in place with minimum compression of the material.

3.19 INSTALLATION OF SOUND ATTENUATORS

A. Vibration Control and Seismic Restraint: Refer to Section 23 05 48 and Drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in Section 23 05 48 and drawing VS-1.

B. General: Install sound attenuators as indicated, and in accordance with manufacturer's installation instructions.

C. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

D. Upon completion of installation test and demonstrate that sound attenuators, and duct connections to sound attenuators, are leak tight.

3.20 INSTALLATION OF AIR OUTLETS AND INLETS

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.21 INSTALLATION OF EXTRUDED ALUMINUM RAIN RESISTANT WALL LOUVERS

A. HVAC Contractor is responsible for installation of Louvers in accordance with the following:

1. Examination

   a. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.
   b. Notify Architect of unsatisfactory preparation before proceeding.

2. Preparation

   a. Clean opening 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. Installation

   a. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
   b. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
   c. Install joint sealants as specified in Section 079200.
   d. Motorized dampers are required at all ducted Louver Connections

4. Cleaning

   a. Clean louver surfaces in accordance with manufacturer's instructions.
   b. Touch-up, repair or replace damaged products before Substantial Completion.

3.22 INSTALLATION OF CONDENSATE DISCHARGE PUMPS

A. Examine areas and conditions under which pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

B. Installation of Equipment

1. General: Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in drain pans and locations indicated, and maintain manufacturer's recommended clearances.
2. Accessories: Install equipment accessories not installed at factory.
3. Connections: Connect discharge piping as indicated and terminate where indicated on the contract documents.
4. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
5. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

C. Field Quality Control

1. General: Start-up equipment, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

D. Closeout Procedures

1. Training: Instruct Owner's personnel in operation and maintenance of condensate discharge pumps.

3.23 INSTALLATION OF VARIABLE AIR VOLUME BOXES

A. VIBRATION CONTROL AND SEISMIC RESTRAINT: Refer to section 23 05 48 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 23 05 48 and drawing VS-1.

B. General: Install variable air volume boxes as indicated, and in accordance with manufacturer's installation instructions.

C. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

D. Install all transformers within junction boxes and maintain three foot clearance in front per the electrical code. This will allow the VAV control box to only utilize low voltage wiring and not be susceptible to the three foot clearance requirement by the electrical code.

3.24 INSTALLATION OF ACCESS DOORS

A. Furnish to General Contractor for installation.

3.25 INSTALLATION OF FIRESTOPPING AND SEALANTS

A. Examination

1. Examine the areas and conditions where firestops are to be installed and notify the architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the architect and in accordance with Section 07 84 13.
2. Verify that environmental conditions are safe and suitable for installation of firestop products.
3. Verify that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

B. Installation in accordance with SECTION 07 84 10 – PENETRATION FIRESTOPPING

C. Installation of acoustic sealant at non rated walls, per the requirements of SECTION 07 92 00 - JOINT SEALANTS.

3.26 INSTALLATION OF CO/NO2 DETECTION AND CONTROL

A. Inspection:

1. General: Examine areas and conditions under which gas monitoring and control system shall be installed. Related items shall be examined as well.

B. Control Sequence:

1. The controller shall operate according to the specifications recommended by the manufacturer. The operation shall be as follows:

a. The controller shall be calibrated to the desired set-points before operation.
b. The controller shall continuously detect the surrounding air for any traces of the gas detected.
c. When the first set-point is reached, the sensor shall activate the low alarm on the controller and the corresponding devices, such as the exhaust fans, dampers, etc.
d. If the gas level continues to increase to the second set-point, the high alarm shall activate with the corresponding devices, such as the audio/visual alarm, etc.
e. The sensor shall continue to trace the specified gas and will not disable the alarm until the gas level is dropped a significant percentage below the alarm set-points.

C. Training:

1. A minimum of three hours of on-site product training is recommended.

D. Operation and Maintenance Manuals:

1. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire gas detection system. This documentation shall include specific part numbers.

E. Calibration:

1. Calibration shall not be necessary to verify system operation. The user shall verify signal transmission from the sensor to the control panel by applying the appropriate test gas to the corresponding sensor. The calibration kit can be used for system verification or sensor calibration when required. One calibration kit per gas to be monitored shall be provided by the installing contractor and turned over as part of their close out documentation to the building owner.

3.27 INSTALLATION OF HEAT RECOVERY (VRF)

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS-1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS-1.

B. General:

1. Verify all dimensions by field measurements. Verify roof structure, mounting supports, wall structure, and membrane installations are completed to the proper point to allow installation of wall mounted and roof mounted units. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation. Do not proceed until unsatisfactory conditions have been corrected.
2. Install equipment in accordance with manufacturer’s installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

C. Field Quality Control:

1. Provide the services, to include a written report, of a factory authorized service representative to examine the field assembly of the components, installation, and piping and electrical connections.
2. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.
3. Provide oil separators and suction accumulators as required and install per manufactures installation instructions and recommendations.
4. Provide additional refrigerant charge as required per the manufactures for pipe lengths exceeding manufactures published data.

D. Pressure test ALL systems to 550 PSI after system was vacuumed and held to below 500 microns for at least one hour. Review manufacturer installation instructions for proper pressure test procedures.

E. Demonstration:

1. Provide the services of a factory authorized service representative to provide start-up service and to demonstrate and train the Owner's maintenance personnel as specified below.
2. Start-up service: Place units into operation and adjust controls and safeties. Replace damaged or malfunctioning components and controls.

F. Training:

1. Train the Owner's maintenance personnel on start-up and shut-down procedures, troubleshooting procedures, and servicing and preventative maintenance schedules and procedures.
2. Schedule training with Owner through the Architect/Engineer with at least 7 days prior notice.

3.28 INSTALLATION OF VEHICLE EXHAUST REMOVAL SYSTEM

A. EXAMINATION

1. Verify that conditions of work previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer’s written instructions prior to installation of engine exhaust removal system.

    a. Notify Architect of unacceptable conditions upon discovery.
    b. Proceed with installation only after unacceptable conditions have been corrected.

B. PREPARATION

1. Prepare work to receive engine exhaust removal system in accordance with manufacturer’s written instructions and approved submittals.

C. INSTALLATION

1. Install engine exhaust removal system in accordance with manufacturer’s written instructions and approved submittals.
2. Accurately fit, align, securely fasten and install free from distortion or defects.
3. Test, adjust and balance for proper operation.
4. Clean, lubricate and adjust moving parts.

D. CLEANING

1. Perform daily progress cleaning.
2. Upon completion, remove surplus materials, rubbish, tools and equipment.
3. Collect recyclable waste and dispose of at appropriate recycling facilities.

E. PROTECTION

1. Protect installed product from damage during construction in accordance with manufacturer’s written instructions.
2. Repair or replace adjacent materials damaged by installation of engine exhaust removal system.

F. MAINTENANCE

1. Maintain engine exhaust removal system in accordance with manufacturer’s instructions and terms of warranty.

3.29 INSTALLATION OF AUTOMATIC TEMPERATURE CONTROLS (DDC)

A. Installation of Control Systems:

1. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
2. Control Wiring: Install control wiring, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.

a. Install circuits over 25-volt with color-coded No. 12 wire in electric metallic tubing.
b. Install circuits under 25-volt with color-code No. 18 wire with 0.031" high temperature 105° F. (41° C) plastic insulation on each conductor and plastic sheath over all.
c. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.
d. Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electrical conduit.
e. Power sources from lighting circuits and wall outlets shall not be used to power DDC controllers.

3. Controllers and safety devices:

a. All safety devices such as freezestats, duct mounted heat detectors, smoke detectors, etc., shall be hard wired to shut down the fans independently. Provide audible alarm with silence switch as well as DDC indication.
b. Humidifier controls shall be hard wired through fan proof flow differential switch and starter auxiliary contacts to disable humidifier system on fan shutdown. Provide DDC indication.
c. All supply, return and exhaust fans shall be provided with pressure differential switches. Current sensing devices, starter axillary contacts, and relay contacts are unacceptable proof of fan operation.
d. Primary and standby pumps shall be selectable through the DDC control system. Provide local pilot light to indicate selected pump as well as alarm and silence switch for failed pump. Provide differential pressure switch to prove flow.

B. Adjusting and Cleaning:

1. Start-Up: Start-up, test, and adjust pneumatic control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
2. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
3. Final Adjustment: After completion of installation, adjust thermostats, control valves, motor and similar equipment provided as work of this section.

a. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

C. Closeout Procedures:

1. Owner's Instructions: Provide services of manufacturer's technical representative for one 8-hour day to instruct Owner's personnel in operation and maintenance of control systems, and 40 hours of onsite instruction on running and basic troubleshooting of DDC control system.
2. Validation: The automatic temperature control contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequence of operation submitted.

a. Witnessed validation demonstration shall consist of:

1) Execute digital and analog commands in English and graphic mode.
2) Demonstrate all specified diagnostics.
3) Demonstrate scan, update, and alarm responsiveness.

3. Training:

a. All training shall be by the automatic temperature control contractor and shall utilize specified manuals and as-build documentation.
b. Operator training shall include:

1) Sequence of Operation review.
2) Sign on-Sign off.
3) Modifying warning limits, alarm limits and start-stop times.
4) System initialization.
5) Use of Portable Operators Terminal.
6) Troubleshooting of sensors (determining bad sensors).
7) Point disable/enable.
8) Software review of Sequence of Operation programs.
9) Modification of control programs.
10) Add/Delete/Modify data points.
11) Use of diagnostics.
12) Review of initialization.

c. Training shall be for Owner-designated personnel at the subject site, and shall be scheduled by the Owner with two week notice.

D. Installation of Gas Detection & Monitoring System:

1. This system is provided as an Emergency Vehicle exhaust system for noxious vehicle exhaust harmful to occupant's health. This system has not been designed to replace and should not be used as a substitute for the primary Vehicle exhaust system provided by the owner.
2. Provide sensors in the quantities and locations indicated on contract documents. Sensors shall be mounted in accordance with the manufacturer's recommendations and fully capable of monitoring Carbon Monoxide and Nitrogen Dioxide levels of each garage indicated in the specifications.
3. In the event the CO/NO2 sensors detect levels indicated in the specifications, the sensors shall activate the associated exhaust fan and run continuously until CO/NO2 levels in the occupied spaces return down to an acceptable safe level for the occupants.

a. All sensors shall be calibrated and installed in accordance with the manufacturer's recommendations.

4. Provided start services for Emergency Vehicle exhaust systems.

3.30 TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

A. Requirements:

1. Requirements include verification of HVAC system operation, measurement of all system capacity, and establishment of the quantities of the mechanical systems as required to meet specifications, and recording and reporting the results.
2. Commission, test, adjust and balance the following mechanical systems:

a. Supply air systems.
b. Return air systems.
c. Exhaust air systems.
d. Outside air systems.
e. Hydronic heating systems.
f. Verify temperature control system operation.

3. Do not include:

a. Testing boilers and pressure vessels for compliance with safety code.
b. Installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing. Contact Mechanical Contractor and the Engineer for direction.

B. Report:

1. Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

a. General Information and Summary.
b. Air Systems.
c. Hydronic heating and cooling systems.
d. Temperature Control Systems.

2. Contents: Provide the following minimum information, forms and data:

a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.
b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC for each respective item and system.
c. Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

C. Quality Assurance:

1. An independent testing, adjusting, and balancing agency certified by the AABC or NEBB as a Test and Balance Engineer in those testing and balancing disciplines required for this project.
2. Codes and Standards:

a. AABC: "National Standards For Total System Balance".
b. ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.
c. NEBB (National Environmental Balancing Bureau: "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" (Latest Edition)

3. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect/Engineer and Mechanical Contractor. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

4. System Operation: Systems shall be fully operational prior to beginning procedures. All new automatic temperature controls shall be fully operational. Test, adjust and balance the air systems before refrigerant systems. Test, adjust and balance air conditioning systems during summer season, and heating systems during winter season, including at least a period of operation at outside conditions within 5° F. wet bulb temperature of maximum summer design condition, and within 10°F. dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.

D. Preliminary Procedures:

1. Air Systems:

   a. Obtain drawings and become thoroughly acquainted with the systems.
   b. Compare drawings to installed equipment and field installations.
   c. Walk the system from the system air handling equipment to terminal units to determine variations in installation.
   d. Check filters for cleanliness.
   e. Check all dampers (volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
   f. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a cross check with required fan volumes.
   g. Determine best locations in main and branch ductwork for most accurate duct traverses. Traverses shall be performed in each supply and return duct main and sub-mains for each AHU and return air fan.
   h. Place outlet dampers in the full open position.
   i. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
   j. Verify lubrication of all motors and bearings.
   k. Check fan belt tension.
   l. Check fan rotation.

2. Hydronic Systems:

   a. Open valves to full open position. Close coil bypass valves.
   b. Remove and clean all strainers.
   c. Examine hydronic systems and determine if water has been treated and cleaned.
   d. Check pump rotation.
   e. Check expansion tanks to verify noted air pressure and that the system is completely full of water.
   f. Check air vents at high points of system and determine if all are installed and operating freely.
   g. Set temperature controls so all coils are calling for full flow.
   h. Check operation of automatic bypass valves.
   i. Check and set operating temperatures of chillers, boilers, and heat exchangers to design requirements.
   j. Verify lubrication of all motors and bearings.

3. Measurements:

   a. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerance specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
   b. Provide instruments meeting the specifications of the referenced standards.
   c. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
   d. Apply instrument as recommended by the manufacturer.

e. Use instruments with minimum scale and maximum subdivisions and with scaled ranges proper for the value being measured.
f. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5%. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
g. Take all reading with the eye at the level of the indicated value to prevent parallax.
h. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
i. Take measurements in the system where best suited to the task.

E. Performing Commissioning, Testing, Adjusting, and Balancing:

1. Test, adjust and balance all noted systems according to SMACNA standards and as follows:

a. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
b. Cut insulation and ductwork for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
c. Patch insulation, ductwork, and housings, using materials identical to those removed.
d. Seal ducts and test for and repair leaks.
e. Seal insulation to re-establish integrity of the vapor barrier.
f. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
g. Retest, adjust and balance system subsequent to significant system modifications, and resubmit test results.

2. System Deficiencies:

a. The Balancing Contractor shall advise the Mechanical Contractor and the Engineer of all system deficiencies in writing. Report all motors not running, missing dampers, inoperative valves and controls, lack of access, etc.
b. Upon completion of system deficiencies, Balancing Contractor shall balance and record data.
c. Any re-balancing required to meet the desired CFM or modified CFM due to system modifications or owner changes shall be provided at no additional costs to the project/owner.
d. The Balancing Sub-subcontractor shall provide the necessary sheave and belt changes to motors and fans as required to achieve the desired CFM at no additional costs to the project/owner.

END OF SECTION

SECTION 23 05 48

VIBRATION CONTROL AND SEISMIC RESTRAINT

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SECTION 23 05 48
VIBRATION CONTROL AND SEISMIC RESTRAINT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. General: The work noted within section 23 05 48 is referenced by divisions 21 00 00, 22 00 00, 23 00 10, and 26 00 10. Provide all necessary labor & material in each division as required herein.

B. Intent:

1. All mechanical equipment, piping, and ductwork shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturer's, and building construction standards. Whenever a conflict occurs between the manufacturer's or construction standards, the most stringent shall apply.
5. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements (i.e. California Title 24, California OSHPD, Canadian Building Codes, or other requirements).
6. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

C. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Equipment isolation bases.
3. Flexible piping connections.
4. Seismic restraints for isolated equipment.
5. Seismic restraints for non-isolated equipment.
6. Certification of seismic restraint designs and installation supervision.
7. Certification of seismic attachment of housekeeping pads.
8. All mechanical and electrical systems. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification).

AC Units
Air Cooled Condensing Units
Air Handling Units
Air Separators
Boilers
Cable Trays
Conduit
Ductwork
Electrical Panels
Fans (all types
Generators
Heat Exchangers
Light Fixtures
Piping
Pumps (all types)
Rooftop Units
Tanks (all types)
Unit Heaters
Var. Freq. Drives
VAV Boxes
Water Heaters

D. Definitions:

1. Life Safety Systems

a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
b. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers, and all flowpaths to fire protection and/or emergency lighting systems.
c. All medical and life support systems.
d. Fresh air & relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

2. Positive Attachment

a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, etc. are not acceptable as seismic anchor points.

3. Transverse Bracing

a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

4. Longitudinal Bracing

a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.3 SUBMITTAL DATA REQUIREMENTS

A. In addition to requirements of Section 013300, the manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:

1. Descriptive Data

a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.

2. Shop Drawings

   a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
   b. Provide all details of suspension and support for ceiling hung equipment.
   c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
   d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

3. Seismic Certification and Analysis

   a. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
   b. All restraining devices shall have a pre-approval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 450 to the weakest mode.
   c. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embodiment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces required acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.4 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes, Standards, and Categories:

1. International Building Code 2021 with an effective peak acceleration coefficient of 0.15.
2. Massachusetts State Building Code, Tenth Edition.
3. Seismic hazard exposure group of I, II, III and seismic performance category of C, D.

1.5 MANUFACTURER'S RESPONSIBILITY

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide vibration isolation and seismic restraints.
3. Provide calculations and materials if required for restraint of unisolated equipment.
4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.6 RELATED WORK

A. Housekeeping Pads:

1. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embodiment.

B. Supplementary Support Steel:

1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof mounted equipment.

C. Attachments:

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.7 DESIGN REQUIREMENTS

A. Design isolators for equipment installed outdoors to provide adequate restraint to withstand the force of a 100 mph wind applied to any exposed surface of the isolated equipment. Isolators for outdoor equipment shall have bolt holes for attachment to equipment and to supports. The vibration isolation Vendor shall submit verifying shear and over turning calculations, for their product and equipment installation arrangement, stamped by a licensed Professional Engineer. The design and supply of miscellaneous support steel above and below isolators will not be the responsibility of the vibration isolation manufacturer.

1.8 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes, with the proper loading to meet the specified deflection requirements.

C. Supply and install any incidental materials such as mounting brackets, attachments and other accessories as may be needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim for additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

E. Should any rotating equipment cause excessive noise or vibration when properly installed on the specified isolators, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

PART 2 - PRODUCTS

2.1 INTENT

A. All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer. Mason Industry's products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification.

B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8 inch and/or horizontal permanent deformation greater that 1/4 inch.

2.2 PRODUCT DESCRIPTIONS

A. Vibration Isolators and Seismic Restraints.
GENERAL:

1. All metal parts installed out-of-doors shall be corrosion resistant after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.
2. Isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.
3. Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor-saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories and seismic restraint features must not degrade the isolation performance of the isolators.
4. Static deflection of isolators shall be as provided in the EXECUTION section and as shown on the drawings. All static deflections stated are the minimum acceptable
5. deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.

SPECIFICATION:

1. Two layers of 3/4" thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16 gauge galvanized shim. Load distribution plates shall be used as required. Pads shall be Type Super "W" as manufactured by Mason Industries, Inc.
2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be Type BR as manufactured by Mason Industries, Inc.
3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in 3 planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge bearing quality. Bushing assemblies shall be type PB as manufactured by Mason Industries, Inc.

4. A one (1) piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact. Neoprene bushings shall be type HG as manufactured by Mason Industries, Inc.
5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be Type SLF as manufactured by Mason Industries, Inc.
6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Pre-approval "R" Number from OSHPD in the state of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be SLR as manufactured by Mason Industries, Inc.
7. Spring mountings as in specification 5 built into ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of 1/4 inch travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be SSLFH as manufactured by Mason Industries, Inc.
8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air Springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8". Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician. Air Springs shall be Type MT and leveling valves Type LV as manufactured by Mason Industries, Inc.
9. Restrained air spring mountings shall have an MT air spring as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces. Mountings shall be SLR-MT as manufactured by Mason Industries, Inc.
10. Hangers shall consist of rigid steel frames containing minimum 1 1/4" thick neoprene elements at the top and a steel spring with general characteristics as in specification 5 seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be type 30° as manufactured by Mason Industries, Inc.

11. Hangers shall be as described in specifications 10, but they shall be pre-compressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
12. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be Type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam all as manufactured by Mason Industries, Inc.
13. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage pre-approval "R" number from OSHPD in the state of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be type SSB as manufactured by Mason Industries, Inc.

Note: Specifications 12 - 14 apply to trapeze as well as clevis hanger locations. At trapeze anchor locations piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

14. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California. Rod clamp assemblies shall be Type SRC as manufactured by Mason Industries, Inc.
15. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose performed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.
16. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4 inch thick. Rated loading shall not exceed 1,000 psi. A minimum air gap of 1/8 inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be Type Z-1 225 as manufactured by Mason Industries, Inc.

17. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" thick. Rated loadings shall not exceed 1,000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" nor more that 1/4". Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to 1/2" deflection in the x, **y** and z planes. Snubbers shall have an anchorage pre-approval "R" number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be series Z-101 1 as manufactured by Mason Industries, Inc.
18. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.0 Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS as manufactured by Mason Industries, Inc.
19. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an evaluation report number from the I.C.B.0 Evaluation Service, Inc. verifying to its allowable loads. Drill-in female wedge anchors shall be type SAB as manufactured by Mason Industries, Inc.
20. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14' provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 ". Bases shall be type WF as manufactured by Mason Industries, Inc.
21. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/1 2 of the longest dimension of the base but not less than 6". The base depth need not exceed 1 2" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 6" centers running both ways in a layer 1 1/2" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1 " clearance below the base. Wooden formed bases leaving a concrete rather then a steel finish are not acceptable. Base shall be type BMK or K as manufactured by Mason Industries, Inc.
22. Roof Curb (by HVAC Contractor)

    a. Curb mounted rooftop equipment shall be mounted on structural spring isolation curbs that bear directly on the roof support structure, and are flashed and waterproofed into the roof's membrane waterproofing system. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal. Springs shall be Type A.
    b. Unit shall be provided with wood nailer and flashing.
    c. Curbs shall meet all NRCA Standards.
    d. Curbs shall be similar to Novia Associates VibCurb III or equal having a minimum 3" rated static deflection or approved equal.

e. Vibration control: The spring roof curb shall have the top isolated or floating rail attached in a manner to the fixed lower portion of the curb without short circuiting or bridging between the two. Restraining bolt(s) or threaded rod shall be of sufficient size to withstand the applied wind & or seismic forces at each spring pack location.
f. An alignment bolt shall be installed before connecting the floating to non-floating parts to guarantee perfect centering of the restraining bolts.
g. Weather proofing & air seal: The spring curb must keep the weather (air and water) out and any airflow from the RTU in. The weather seal must not have the ability to fail and allow water or air into the building.
h. The use of exposed exterior neoprene or some other elastomer material to seal the top floating rail from the base of the curb in not acceptable.
i. Vibration Mountings: Provide a rubber gasket covered by formed galvanized sheet metal top flashing that overhangs the top wood nailer and galvanized bottom flashing. The overlapping shall effectively cover the rubber gasket so it is protected from the elements.
j. The top flashing / support rail shall be 14 ga. G60–Zc steel formed with 90 bends that extend down to the wood nailer. Provide a counter flashing member with a sponge gasket attached that presses up against the horizontal bend. The seal shall be replaceable, protected from the elements and easy to install.
k. Curb side material: Provide 12 Ga. G60 galvanized steel for curb side construction. All side and end seam between sheets shall be continuously welded, corner joints to be caulked and bolted.
l. Structural Capability:
    1) Curbs shall be installed on metal decking/concrete slab. Air handling unit load shall be properly distributed. Coordinate curb construction with pitch of roof. Curbs shall be built to match the roof pitch in accordance with all requirements of this project. Positive attachment of the curb to the structure is imperative. Pitch correction shall be fabricated from 12 gauge galvanized material and be continuous on all sides and ends. Field fabricated and installed tube steel stub-ups are not acceptable. HVAC contractor shall provide detailed information to the curb manufacturer regarding pitch correction.
    2) Plenum Sections: The side material must be capable of handling the static pressure developed by the fans and not ‘oil can’. Provide spanning bar joists as required to support plenum installation (even when the spring pockets are center span).
    3) Provide a continuous bottom tube steel member or side material of sufficient strength. Mechanical contractor shall coordinate and verify all dimensions, weights, roof penetrations, etc. with the Structural Engineer prior to installation.
    4) Curb Insulation: Provide spring curbs with a space between the floating and non-floating parts for the installation of insulation. Curb manufacturer shall provide factory installed insulation adhered to roof curb. Curbs shall be externally factory insulated with a 1.7” thick R-12 foam insulation, FM Class 1 and UL Class A Ratings, with bonded fiber reinforced facer.

m. Protection: Curbs shall be completely shrink-wrapped during shipping.
n. Mechanical contractor shall provide all necessary materials to completely weather proof and sound proof the curb installation.

o. Additional features:

1) Sound barrier: Provide a sound barrier package, consisting of G60 galvanized back-to-back angles. Sound barrier package shall be capable of supporting two layers of 1/2" Durock concrete board with a maximum deflection over the width of the curb of L/360. Durock furnished and installed by the HVAC Contractor. Overlap all joints, caulk all seams and edges. Transmission Loss & STC shall be as shown as follows. Sound Transmission Loss at Frequency (Cycles per second) of (125)=20, (250)=27, (500)=30, (1000)=32, (2000)=30, (4000)=38, (STC)=31.

2) Provide with framed Supply & Return air duct openings. Openings shall match duct sizes and have 1" galvanized steel flanges.

3) Plenum sections: Where indicated on the drawings, provide in the interior of the curb, double wall acoustical floor, walls and plenum divider. All insulation shall be 2" thick fiber glass acoustical duct liner with reinforced coating system. Insulation acoustical performance shall be as follows. Liner shall not support microbial growth and shall be EPA registered and pass ASTM C 1071 & ASTM G21 bacterial tests conducted in accordance with ASTM G22. Floors up to 90" curb I.D. width shall be constructed of 22 Ga., 20 Ga. thereafter, solid G60 galvanized bottom panels and 22 Ga. galvanized perforated 22.7% open area top panel. Floor shall be attached to walls and plenum divider to provide an airtight plenum. Walls shall have 22 Ga. galvanized perforated 22.7% open area inside panels. Plenum divider shall be double wall 22 Ga. perforated galvanized 22.7% open area panel on the supply side with a 14 gauge solid panel opposite. Sound Absorption Coefficient at Frequency (Cycles per second) of (125)=.23, (250)=.64, (500)=.99, (1000)=1.05, (2000)=1.00, (4000)=.98, (NRC)=.90,

23. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Dacron tire cord friction ring. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16' to 24" may be single sphere. Sizes 3/4" to 1 1/2" may have threaded bolted flange assemblies, one sphere and cable retention. 14" and smaller connectors shall be rated at 250 psi up to 190°F. with a uniform drop in allowable pressure to 190 psi at 250°F. 16" and larger connectors are rated 180 psi at 190°F. and 135 psi at 250°F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.
Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have 1/2" thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut off valves.
Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

24. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged		Male Nipples	
3 x 14	10 x 26	½ x 9	1-½ x 13
4 x 15	12 x 28	¾ x 10	2 x 14
5 x 19	14 x 30	1 x 11	2-1/2 x 18
6 x 20	16 x 32	1-1/4 x 12	
8 x 22			

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS as manufactured by Mason Industries, Inc.

25. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.
26. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of + 1 5/8" motion, or to meet location requirements. Pipe guides shall be type VSG as manufactured by Mason Industries, Inc.
27. Split Wall Seals consist of two bolted pipe halves with minimum 3/4" thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of I" past either face of the wall. Where temperatures exceed 240°F., 10# density fiberglass may be used in lieu of the sponge. Seals shall be Type SWS as manufactured by Mason Industries, Inc.
28. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the duct work or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD as manufactured by Mason Industries, Inc.

PART 3 - EXECUTION

3.1 GENERAL

A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data. At the completion of all construction work the vibration and seismic device supplier shall inspect all installations and provided a written report of installation compliance to the engineer of record. A copy of this written certification shall also be provided in the operations manual provided to the owner.

B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

D. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate work with other trades to avoid rigid contact with the building.

F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

G. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.

H. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.

I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:

1. Flanges of structural beams.
2. Upper truss cords in bar joist construction.
3. Cast in place inserts or wedge type drill-in concrete anchors.

J. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.

K. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.

L. At locations where specification 12 or 13 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 14 braces.

M. At all locations where specification 12 or 13 restraints are attached to pipe clevis's, the clevis cross bolt must be reinforced with specification type 15 braces.

N. Drill-in concrete anchors for ceiling and wall installation shall be specification type 18, and specification type 19 female wedge type for floor mounted equipment.

O. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.

P. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed specification 23 capabilities.

Q. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide specification 27 wall seals.

R. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be specification type 28.

S. Locate isolation hangers as near to the overhead support structure as possible.

3.2 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF PIPING, DUCTWORK, AND CONDUIT

A. Where piping connects to rotating or vibrating mechanical equipment install specification 23 expansion joints or specification 24 stainless hoses if 23 is not suitable for the service.

B. Seismic Restraint of Piping:

1. Seismically restrain all piping listed as a, b or c below. Use specification 12 cables.

   a. Fuel oil piping, gas piping, medical gas piping, and compressed air piping.
   b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1 1/4" I.D. and larger.
   c. All other piping 2 1/2" diameter and larger.

2. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
3. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
5. For fuel oil and all gas piping transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
6. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.
7. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
8. Branch lines may not be used to restrain main lines.

C. Pipe Isolation

1. All chilled water, condenser water, hot water, steam, refrigerant, drain and engine exhaust piping that is connected to vibration-isolated equipment shall be isolated from the building structure within the following limits:

   Within mechanical rooms;

   Within 50' total pipe length of connected vibration-isolated equipment (chillers, pumps, air handling units, pressure reducing stations, etc.);
   At every support point for piping that is greater than 4 inches in diameter.

2. Piping shall be isolated from the building structure by means of vibration isolators, resilient lateral supports, and resilient penetration sleeve/seals.

3. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than 1/2", Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to 1/2", Type FN or HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or HN achieving at least 1/4" static deflection.
4. Where lateral support of pipes is required within the specified limits, this shall be accomplished by use of resilient lateral supports.
5. Pipes within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
6. Provide flexible pipe connections as called for under Major Equipment above and wherever shown on the drawings.

D. Seismic restraint of ductwork:

1. Seismically restrain all duct work with specification 12 or 13 restraints as listed below:

   a. Restrain rectangular ducts with cross sectional area of 6 sq. ft. or larger.
   b. Restrain round ducts with diameters of 28" or larger.
   c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.

2. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
3. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4' of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
6. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.

E. Duct Isolation:

1. All sheet metal ducts and air plenums that are within mechanical rooms or within a distance of 50' total duct length of connected vibration-isolated equipment (whichever is longer) shall
2. be isolated from the building structure by Type FN, PCF or HN isolators. All isolators shall achieve 0.1" minimum static deflection.
3. Ducts within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
4. Flexible duct connections shall be provided as called for above under Major Equipment and wherever shown on the drawings.

F. Seismic Restraint of Electrical Services:

1. All electrical conduit 2-1/2" in diameter and larger shall be restrained with specification type 12 seismic cable restraints or specification type 13 for seismic solid brace restraints.
2. All electrical bus ducts, cable trays and ladder trays shall be restrained with specification type 12, seismic cable restraints or specification 13 seismic solid brace restraints.

3. Transverse restraints shall occur at 30' intervals or both ends if the electrical run is less than the specified interval. Transverse restraints shall be installed at each electrical services turn and at each end of the electric run.
4. Longitudinal restraints shall occur at 60' intervals with at least one restraint per electric run. Transverse restraints for one electric section may also act as a longitudinal restraint for a duct for an electric section connected perpendicular to it if the restraints are installed within 4' of the intersection of the electric run and if the restraints are sized for the larger electric run.
5. All rigid floor mounted equipment must have a resilient media between the equipment mounting hole and the anchor bolt. Neoprene bushings shall be specification type 4 and anchor bolts shall be specification type 18 or 19.
6. Wall mounted panels shall be mounted with specification type 3 bushings. Floor mounted panels shall be mounted on specification type 4 bushings. Anchor bolts shall be specification type 18 or 19.

G. All fire protection piping shall be braced in accordance with NFPA 13 and 14.

H. All mechanical equipment shall be vibration isolated and seismically restrained.

1. All fire protection equipment is considered life safety equipment and shall be seismically restrained.

3.3 SEISMIC RESTRAINT EXCLUSIONS

A. Piping:

1. All piping less than 2 1/2” except for gas and fire protection piping.
2. All piping in boiler and mechanical equipment rooms less than 1 1/4" I.D.
3. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12" in length from the structure to the structural connection of the clevis or trapeze.
4. All PVC and fiberglass suspended waste or vent pipe 6" in diameter and smaller.

B. Ductwork:

1. Rectangular, square or oval ducts less than 6 sq. ft. in cross sectional area.
2. Round duct less than 28" in diameter.
3. Duct supported by hanger rods where the point of attachment is less than 12" in length from the structure to the structural connection of the duct work.

C. Electrical:

1. All conduit less than 2 1/2" diameter suspended by individual hanger rods.
2. All clevis or trapeze supported conduits suspended by hanger rods where the point of attachment is less than 1 2" in length from the structure to the structural connection of the clevis or trapeze.

3.4 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with the manufacturer's instructions.

B. Isolators

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
2. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the equipment shaft unless this is not possible because of physical constraints.
3. Locate isolators to provide stable support for equipment, without excess rocking.
4. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called for herein.
5. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.
6. Hanger rods for vibration-isolated support shall be connected to major structural
7. members, not the floor slab between major structural members. Provide suitable
8. intermediate support members as necessary.
9. Vibration isolation hanger elements shall be positioned as high as possible in the
10. hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.
11. Parallel running pipes may be hung together on a trapeze that is isolated from the
12. building. Isolator deflections must be the greatest required by the provisions for pipe
13. isolation for any single pipe on the trapeze. Do not mix isolated and unisolated pipes on the same trapeze.
14. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
15. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
16. The installed and operating heights of equipment supported by Type FSNTL isolators or with Type RC-2 isolation bases shall be identical. Limit stops shall be out of contact
17. during normal operation. Adjust isolators to provide 1/4" clearance between the limit
18. stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.
19. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.
2. Unless otherwise indicated, there is to be a minimum operating clearance of 1" between steel rails, steel frame bases or inertia bases and the floor beneath the equipment. The isolator mounting brackets shall be positioned and the isolators adjusted so that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.
3. Isolation bases shall be installed in strict accordance with the manufacturer’s instructions.

D. Flexible Duct Connections:

1. Prior to installation of the flexible connection, sheet metal ducts and plenum openings shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section, and the gap between connected parts shall be uniform. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

E. Flexible Pipe Connections:

1. Install flexible pipe connections in strict accordance with the manufacturer's instructions.

F. Thrust Restraints:

1. Thrust restraints shall be attached on each side of the fan parallel to the thrust force. This may require custom brackets or standoffs. The body of the thrust restraint shall not come in contact with the connected elements. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.

G. Grommets:

1. Where grommets are required at hold down bolts of isolators, bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers shall be galvanized.

H. Resilient Penetration Sleeve/Seals:

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

END OF SECTION

SECTION 260010

ELECTRICAL
(Filed Sub-Bid Required)

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END OF INDEX

SECTION 260010

ELECTRICAL
(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 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. Time, Manner and Requirements for Submitting Sub-Bids:

1. 1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Awarding Authority at a time and place as stipulated in the "NOTICE TO CONTRACTORS".

   The following should appear on the upper left hand corner of the envelope:

   NAME OF SUB-BIDDER: (Insert name of sub-bidder)

   MASS. STATE PROJECT: ((Insert project number from top of page))

   SUB-BID FOR SECTION: 260010 – ELECTRICAL

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the _ Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements:

Class of Work	Section Number
Communications	27 00 00
Emergency Responder Radio Signal Amplification System (BDA System)	27 53 19

If Sub-Bidder intends to perform with persons of his own staff the classes of work listed above, he must nevertheless list his own name therefore, under Paragraph E, of the FORM FOR SUB-BID.

D. The Work of this Section is shown on the following Drawings: E001, E002A, E002B, E003, E004, E005, E101, E102, E103, E201, E202, E203, E204, E205, E300, E300B, E301, E302, E303, E304, E305, E306, E307, E400, E401, E402, E403, E500, E501, E502, E503, ED101, ED102, ED103

The Sub-Bid Contractor shall also examine all other Drawings and all other Sections of the Specifications for requirements therein affecting the Work of this Section, not just those pertaining to this Sub-trade.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 01 Section “Summary.”

1.3 GENERAL REQUIREMENTS

A. The Conditions of the Contract and General Requirements of the Project Manual apply to this Subcontractor, material suppliers, and all other persons furnishing labor and materials under this Section. The General Conditions, and applicable parts of Division 01 are included as part of this Section.

B. Examine all Project Specifications and Drawings for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. The following definitions apply to the Drawings and Specifications:

1. Furnish: The term "furnish" is used to mean "supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations".
2. Install: The term "install" is used to describe operations at the Project Site including actual "unloading, unpacking, assembly, erection, piecing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".
3. Provide: The term "provide" is used to mean "furnish and install, complete and ready for the intended use".
4. Installer: An "installer" is the Contractor or an entity engaged by the Contractor, either as an employee, Subcontractor, or Sub-Subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

E. When open-flame or spark producing tools such as blow torches, welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four (24) hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain constant non-working fire watch where work is being performed until it is completed.

1.4 DESCRIPTION OF WORK

A. Work described herein shall be interpreted as work to be done by the Electrical Sub-Contractor. Work to be performed by other trades will be referenced to a particular contractor.

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. Systems may be referenced in singular or plural terms, also refer to drawings to confirm quantities.

C. The work shall consist of, but shall not necessarily be limited to the following:

1. Primary, secondary and low tension ductbanks, manholes, and handholes.
2. Secondary distribution equipment, including distribution panels, metering, motor controls, variable frequency drives, panelboards, including feeders and subfeeders.
3. Fire alarm system, addressable type.
4. Emergency power system, including diesel fueled emergency generator, emergency lighting and exit signs.
5. Lighting systems exterior and interior fixtures, and a complete automated addressable lighting control system with all sensors occupancy, daylight, photosensors, switches and Bacnet BMS integration.
6. All raceway systems, including boxes, couplings, and fittings.
7. All branch circuit wiring systems, including wiring devices and plates.
8. Excavation and backfill within building foundation walls for any underground raceways.
9. Connections for all building equipment, including mechanical, plumbing, fire protection, elevator, Owner furnished equipment, and the like.
10. Drilling, coring, and cutting of holes for electrical conduit systems, and equipment. Where the electrical contractor requires the G.C. to provide cutting and patching the E.C. shall reimburse the G.C. for the work done. Any cutting caused by the E.C. that causes delay due to poor coordination of the sequencing of work shall be reimbursed by the contractor performing the work.
11. Systems Identification.
12. Scaffolding, Rigging, and Staging required for all Electrical Work under (8) Eight ft. in height. Refer to Section 01 50 00 – Temporary Facilities and Controls.
13. Firestopping for all Electrical Systems. Refer to Section 07 84 10 – Firestopping.
14. Provide Seismic Restraints for all Electrical Systems conforming to the requirements of Section 23 05 48 which Section is herein incorporated by reference.
15. Coordination Drawings and BIM coordination.
16. Lightning Protection System.
17. Uninterruptible Power Supply, UPS System.
18. Communications system provisions including 120 volt power sources, cable tray, j-hooks, raceways and backboxes for Communications Systems as shown on drawings and specified in Section 27 00 00, Communications.
19. Integrated Electronic Security System provisions, IESS including 120 volt power sources, cable tray, j-hooks, raceways, and backboxes for security systems as shown on drawings. Coordination with the owner’s security vendor responsible for installing and wiring equipment for the IESS system.
20. Demolition of existing site electrics.
21. Sealing of all penetrations through walls, slabs, partitions, that are not fire rated.
22. Emergency Responder radio signal amplification system, BDA System. Provisions, and Pretest. Refer to section 27 53 19.
23. Power wiring to Variable Frequency Drives, refer to Section 230010 HVAC (Automatic Temperature Controls).
24. Two-way Communications call boxes system.
25. Provisions for Photovoltaic System as indicated on plans.
26. Temporary light and power, refer to Section 01 50 00 – Temporary Facilities and Controls.
27. Automated Lighting Control System, including start-up, programming, and coordination with Owner for the schedules and scene programs.
28. Access Doors and frames - Refer to Section 08 31 13.

29. All testing of equipment installed.
30. Alternates affecting this section
31. Electrical multi-metering
32. Any other item of work hereinafter specified or indicated on electrical drawings.

1.5 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. Reviewed: When used to convey Designer's action on General Contractor's submittals, applications and requests, "reviewed" is limited to Designer's duties and responsibilities as stated in the Conditions of the Contract.
2. Directed: A command or instruction by Designer. Other Terms including "requested", "authorized", "selected", "approved", "required" and "permitted" have the same meaning as "directed".
3. Indicated: Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown", "noted", "scheduled" and "specified" have the same meaning as "indicated".
4. Regulations: Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions and agreements within the construction industry that control performance of the Work.
5. Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation and similar operations.
6. Install: Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
7. Conduit: Raceways of the metallic type which are not flexible. Specific types as specified.
8. Connect: To wire up, including all branch circuitry, control and disconnection devices so item is complete and ready for operation.
9. 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.
10. Provide: Furnish and install completely connected up and in operable condition.

B. General: Basic Contract definitions are included in the Conditions of the Contract including, but not limited to, the following:
1. The Designer (the Architect-of-Record or Engineer-of-Record as applicable.)
2. The Owner's Project Manager.
3. The General Contractor.

1.6 ITEMS TO BE FURNISHED ONLY

A. Furnish the following items for installation under designated sections.

1. Duct smoke detectors and duct carbon monoxide detectors with sampling tube, Section 230010 – HVAC.
2. Manholes and handholes – installed by Site Contractor.
3. Access Doors and Frames - Section 08 31 10.
4. Pre-cast pole bases to be installed by Site contractor.
5. Pre-cast transformer pad to be installed by Site contractor

1.7 ITEMS TO BE WIRED ONLY

A. Install the following items furnished under designated sections.

1. Specialty Backboxes for Communications, Security, and Audio/Visual, i.e; Speakers.: Division 27 and Division 28.

1.8 RELATED WORK

A. The following related work is to be performed under designated sections.

1. Temp. Controls – SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.
2. Excavation and Backfill: DIVISION 31 – EARTHWORK (except within building foundation).
3. Concrete pads, and Duct Envelopes: DIVISION 03 - CONCRETE.
4. Insulation - SECTION 07 21 00 – THERMAL INSULATION.
5. Finish Painting: SECTION 09 90 00 –PAINTING AND COATING.
6. Payment for energy for temporary light and power shall be made by General Contractor. Refer to SECTION 01 50 00, TEMPORARY FACILITIES AND CONTROLS.
7. Automatic Temperature Control: SECTION 230010 - HEATING, VENTILATING & AIR CONDITIONING.
8. Hardware: SECTION 08 71 00 – DOOR HARDWARE
9. Communications System Equipment and Wiring: SECTION 270000 – COMMUNICATIONS.
10. Integrated Electronic Security System by owners security vendor under ITC71 State contract
11. Temporary Light and Power – Section 015000 - TEMPORARY FACILITIES AND CONTROLS.
12. Fire stopping: Section 078410 - PENETRATION FIRESTOPPING.
13. Scaffolding, Rigging, and Staging required for all Electrical Work over (8) Eight ft. in height. Refer to section 015000 – TEMPORARY FACILITIES AND CONTROLS.
14. Emergency Responder Radio Communications System, BDA equipment and wiring: Section 275319.

1.9 CONTRACT COST BREAKDOWN

A. Submit a breakdown of contract price to aid Architect in determining value of work installed as job progresses.

1.10 INSPECTION OF SITE

A. Electrical bidders will be permitted to 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.

1.11 CONTRACTOR'S REPRESENTATIVE

A. Retain a competent representative on the project.

1.12 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.

1.13 CODES, ORDINANCES, AND PERMITS

A. Codes and Ordinances:

All material and work provided shall be in accordance with all applicable codes including the following codes and standards as most recently amended.

State Building Code
Massachusetts Electric Code, 2023 Edition
State Department of Public Safety
NFPA 101 Life Safety Code
NFPA Standards
NEMA TCB 2-2017
Standards of the Underwriters Laboratories (UL)
Occupational Safety and Health Act (OSHA)
Americans with Disabilities Act (ADA)
Energy Conservation Code
Motorola R56 Standard
Town of N. Reading

B. Where contract documents indicate more stringent requirements than codes, the contract documents shall take precedence.

C. Permits: Be responsible for filing documents, and securing of inspection and approvals. Pay all permit fees.

D. Refer to INSTRUCTIONS TO BIDDERS. Utility company backcharges related to permanent service will be paid by Owner.

1.14 ELECTRICAL ROOMS OR SPACES

A. Be responsible for ensuring that the dedicated space and clearances required in the NEC, Sections 110-26 are 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.

1.15 SUBMITTALS

A. Refer to Supplementary General Conditions for information relative to submission of shop drawings. Submittals shall be electronic in PDF format. No equipment shall be installed prior to approval.

B. Notwithstanding any restrictions upon contractor proposed substitutions, should apparatus or materials be permitted by Architect to be substituted for those specified for good cause, and such substitution necessitates changes in or additional connections, piping, supports, or construction, same shall be provided. Assume cost and entire responsibility thereof.

C. Submit the following samples:

1. Lighting fixtures as may be requested.
2. Other items as may be requested.

D. Refer to Section 01 30 00 – Submittal procedures, for requirements.

1.16 GUARANTEE

A. All parts of the work shall be guaranteed for a period of one year from the date of acceptance of the job by Owner. If during that period of general guaranty, any part of the work fails, becomes unsatisfactory, or does not function properly due to any fault in material or workmanship whether or not manufactured or job built, the Owner shall upon notice from owner promptly proceed to repair or replace such faulty material or workmanship without expense to owner, including cutting, patching, and painting, or other work involved, and including repair or restoration of any damaged sections of the premises resulting from such faults.

B. In the event that a repetition of any one defect occurs indicating the probability of further failure and which can be traced to faulty design, material, or workmanship, then repair or replacement shall not continue to be made but the fault shall be remedied by a complete replacement of the entire defective unit.

C. In addition to the general guaranty, obtain and transmit to owner any guaranties or warranties from manufacturers of specialties, but only as supplementary to the general guaranty which will not be invalidated by same.

1.17 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 4.0 KW and less shall be suitable for 120 volt single-phase operation. Over 4.0 KW 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 percent under rated load conditions.

1.18 TEMPORARY ELECTRICAL SUPPORT FACILITIES

A. Refer to Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.

B. Provide own field office and/or storage facilities which shall be located as directed by the Architect. Provide all tools, equipment, ladders, and temporary construction required for execution of the work.

C. All scaffolding, ladders, and other temporary construction shall be rigidly built in accordance with all local and state requirements, and shall be removed upon completion.

1.19 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 shall have phases balanced as near as practical. A consistent phase orientation shall be adhered to at all terminations.

1.20 ENERGY REBATE PROGRAM

A. This project has been designed to incorporate equipment approved for energy rebate such as fixtures, performance lighting, building lighting controls, and VFDs. Meet with Utility Company prior to lighting shop drawing submittal to ascertain that submittal meets program guidelines. Fixtures shall be DLC listed or equivalent. Assist Owner and Engineer in effort to obtain utility rebates the Owner is eligible for. Equivalent lighting fixtures which meet DLC shall require lighting vendor to submit shop drawings to utility company for approval. It is the intent of this project to Qualify for incentives which requires an additional 30 days of reported kWh saved and six months of lighting energy use data as reported by the system post-insallation.

1.21 RECORD DRAWINGS

A. Refer to Section 017839 - PROJECT RECORD DOCUMENTS for additional requirements. Provide two sets of black or blue line on white drawings to maintain and submit record drawings, one set shall be maintained at site and which shall be accurate, clear, and complete showing actual location of all equipment as installed. Record drawings shall be updated at least monthly. Record drawings shall show outlet from which homeruns are taken, and location of all junction boxes and access panels. These drawings shall be available to Architect/Engineer field representative.

B. Any addenda sketches and supplementary drawings issued during course of construction shall be incorporated in drawings.

C. At completion, submit an accurate checked set of drawings.

D. After approval of these drawings, photo reproductions of original tracings shall be revised to incorporate changes, including addenda sketches and supplementary drawings. Fitup drawings for tenant areas shall also be revised in the same manner. These "as-built" photo reproductions shall be certified as correct and delivered to the Architect along with two (2) sets of black line prints and Auto CAD files on thumb drive of all changes.

1.22 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Operating Instructions: Refer to Section 01 78 00 - Furnish operating instructions to Owner's designated representative with respect to operations, functions and maintenance procedures for equipment and systems installed. Cost of such instruction up to a full three (3) days of Electrical Subcontractor's time shall be included in contract. Cost of providing a manufacturer's representative at site for instructional purposes shall also be included.

B. Maintenance Manuals:

1. At completion of the project, provide four copies of complete manuals containing the following:

a. Complete shop drawings of equipment.
b. Operation description of systems.
c. Names, addresses, and telephone numbers of suppliers of systems.
d. Vendors' P.O. numbers for equipment installed.
e. Preventive maintenance instructions for systems.
f. Spare parts list of system components.

2. All information shall be in one binder.

1.23 COORDINATION DRAWINGS

A. Refer to Division 01 – General Requirements, before materials are purchased or work is begun, prepare and submit to the Architect, Coordination Drawings showing the size and location of all equipment and piping lines relevant to the complete system. Ensure that these Drawings are compatible and correctly annotated and cross-referenced at their interfaces.

B. The General Trades Contractor shall be responsible for the coordination of all mechanical Plumbing, fire protection and electrical work. Before materials are fabricated or work begun, he shall submit to the Architect complete Coordination NavisWorks file and whatever medium the subcontractor uses to transmit shop drawing information to the field.

C. The NavisWorks model represents what must be installed. Any deviation from the model will be noted and incorporated into the drawings both paper and 3D. If field installation management decides to deviate from the detailed coordination drawings, they are under responsibility for all collisions, schedule, or financial issues caused by the deviation.

D. If two systems are found to have an issue that was not previously resolved in the model and both systems were drawn dimensionally correct and to origin, the issue will be resolved by a meeting of the field supervision to decide the best course of action. If an error in the 3D drawings has caused the issue, the subcontractor with erroneous drawings will be under the responsibility to find a solution.

E. The Subcontractors will be solely responsible for Quality Control and the assurance that field ins tallation matches shop drawings.

F. Coordination Drawings shall indicate the necessary offsets for all ductwork, piping, conduit, and other items to clear the work of all other trades and to maintain the required ceiling height and partition layout. Each subcontractor shall indicate both top and bottom elevations of their equipment taking into account hangers, flanges, and other accessories.

G. Prepare Coordination Drawings as follows:

1. The General Trades Contractor shall require the HVAC Subcontractor to prepare original Drawings showing all his/her equipment, ducts, and piping.
2. The General Trades Contractor shall then require the PLUMBING Subcontractor to indicate all Plumbing piping and heating lines.
3. The General Trades Contractor shall then require the FIRE PROTECTION Subcontractor to indicate all his/her equipment and piping.
4. The General Trades Contractor shall then require the ELECTRICAL Subcontractor to indicate all his/her equipment and conduit.
5. The General Trades Contractor shall resolve conflicts and then submit these Drawings to the Architect for review.

H. Coordination Drawings shall bear the signature of all Subcontractors involved indicating 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". Drawings without these notations will not be accepted by the Architect.

I. If any space conflicts cannot be resolved by the Contractor, he shall immediately notify the Architect and request disposition of the conflict.

J. Coordination Drawings are for the Contractor's and Architect's use during construction and shall not be construed as replacing any Shop, "As-Built", or Record Drawings required elsewhere in these Contract Documents.

K. Architect's review of Coordination Drawings shall not relieve the Contractor from his overall responsibility for coordination of all work performed pursuant to the Contract or from any other requirement of the Contract.

L. Refer to Section 017839 - PROJECT RECORD DOCUMENTS for further requirements and procedures.

1.24 RETURN AIR PLENUM

A. All wiring above suspended ceilings shall be "UL Listed" plenum rated cable or wiring shall be installed in conduit.

1.25 COMMUNICATIONS AND IESS SYSTEM

A. The work shall be so performed so that the progress of the entire building construction, including all other trades, shall not be delayed and not interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as directed.

1. The Electrical Contractor shall be responsible for furnishing and installing: conduits from each door strike, latch, mag lock, door contact, electric closures, card reader, etc. to an accessible ceiling space. Provide power and fire alarm interface at each power supply, door controller requiring same.

B. Responsibilities of the Communications System, and BDA System Contractors: The Communications System Contractor and BDA System Contractor, will be responsible for furnishing, installing, wiring, programming, troubleshooting, training and warranty service of all cabling, terminal equipment, headend equipment, as specified in Section 27 00 00, of Section 26 53 19 for completely operational systems.

C. The work shall be so performed so that the progress of the entire building construction, including all other trades, shall not be delayed and not interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as directed.

D. Responsibilities of the Electrical Contractor: The Electrical Contractor shall be responsible for furnishing and installing all related building preparation including, but not limited to: outlet boxes with plaster rings, 120 volt, power, surface raceways, conduits with bushings, conduit stubs with bushings, sleeves with bushings (all conduits, stubs, sleeves, etc. shall be brought to an accessible ceiling of the same floor), backboxes, plaster rings, pull strings, j-hooks (every 5 feet along main paths to communications closets), bonding, grounding, core drilling, cutting, environmental seals, seismic supports, etc., for a completely operational system, as specified. Special backboxes furnished Security System Contractor and Communications System Contractor, shall be installed by Electrical Contractor.

1. The Electrical Contractor shall be responsible for furnishing and installing: conduits from each door strike, latch, mag lock, door contact, electric closures, card reader, etc. to an accessible ceiling space. Provide power and fire alarm interface at each power supply, door controller requiring same.
2. The Electrical Contractor shall be responsible for coordinating with the Owners security vendor for locations, heights, etc. of provisions.

E. Responsibilities of the Communications System Contractors: The Communications System Contractor will be responsible for furnishing, installing, wiring, programming, troubleshooting, training and warranty service of all cabling, terminal equipment, headend equipment, as specified in Section 27 00 00 for a completely operational system.

F. Responsibilities of the Integrated Electronic Security Systems (IESS) Contractor also referred to as ITC 71 State Contract Vendor or Owner's Security Vendor will be responsible for furnishing, installing, wiring, programming, trouble shooting, training, and warranty service of all cabling, terminal equipment, and head-end equipment for a completely operational system.

G. Keep fully informed as to the shape, size and position of all openings required for all apparatus and give information in advance to build openings into the work.

H. All distribution systems which require pitch or slope such as plumbing drains, steam and condensate piping shall have the right of way over those which do not. Confer with other trades as to the location of pipes, ducts, lights and apparatus and install work to avoid interferences.

I. Coordinate exact locations and roughing in dimensions of all work before installation and make all final connections as required. Any changes required to avoid interference or to provide adequate clearances for Code and maintenance requirements shall be made at no additional costs.

J. Structural elements of the project shall not be relocated, altered or changed to accommodate the work without written authorization from the Architect.

K. Work that is installed before coordination with other trades, or that causes interference with the work of other trades shall be changed to correct condition.

L. Obtain a complete set of Project Drawings and Specifications for coordination and to determine the full scope of work.

M. Attend project coordination meetings to coordinate work of this Section, work of other trades and project and phasing retain a complete set of Project Drawings and Specifications for coordination and to determine the full scope of work.

N. Electrical Contractor shall work closely with the Technology and Security System Contractors to assure a first class installation. Coordinate all back boxes and conduits required prior to installations. In general, the electrical contractor shall provide conduits from outlets to accessible ceiling spaces.

1.26 TEMPORARY LIGHT & POWER

A. Refer to Section 01 50 00– TEMPORARY FACILITIES AND CONTROLS.

1.27 TRADE RESPONSIBILITY FOR INTERCONNECTIONS MATRIX

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
Smoke Detectors (Area type)	26 00 10	26 00 10	26 00 10	230010 (ATC)	26 00 10	
Smoke Detectors & Carbon Monoxide Detectors (Duct mounted)	26 00 10	230010	26 00 10	230010 (ATC)	26 00 10	
Smoke & Fire/Smoke Dampers	230010	230010	N/A	N/A	N/A	
Smoke & Fire/Smoke Damper Actuators	230010	230010	26 00 10 & 230010 (ATC)	230010 (ATC)	26 00 10	2
Fire Dampers	230010	230010	N/A	N/A	N/A	
VAV Boxes	230010	230010	26 00 10	230010 (ATC)	N/A	2
VAV Box Damper Actuator	230010 (ATC)	Box Mfr	230010 (ATC)	230010 (ATC)	N/A	2
VAV Box DDC Controller	230010 (ATC)	Box Mfr	230010 (ATC)	230010 (ATC)	N/A	2
Hydronic Control Valves	230010 (ATC)	230010	N/A	230010 (ATC)	N/A	1
Hydronic Control Valve Actuator	230010 (ATC)	23 09 23	230010 (ATC)	230010 (ATC)	N/A	1
Sheet Metal Damper	230010	230010	N/A	N/A	N/A	1

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
Sheet Metal Damper Actuators	230010 (ATC)	23 09 23	230010 (ATC)	230010 (ATC)	N/A	1
Natural Gas Energy Meters	220000	220000	26 00 10 & 230010 (ATC)	230010 (ATC)	N/A	3
Electrical Energy Meters	26 00 10	26 00 10	26 00 10 & 230010 (ATC)	230010 (ATC)	N/A	3
Domestic Water Meters	220000	220000	26 00 10 & 230010 (ATC)	230010 (ATC)	N/A	3
HVAC Hydronic Energy Meters	230010	230010 (ATC)	26 00 10 & 230010 (ATC)	230010 (ATC)	N/A	3
Airflow Measuring Stations	230010 (ATC)	230010 (ATC)	N/A	230010 (ATC)	N/A	
DDC Panels	230010 (ATC)	230010 (ATC)	26 00 10 & 230010 (ATC)	230010 (ATC)	N/A	4
VFDs at RTU, MAU, AHU, HV & ERV	230010	230010	260010 & 230010	230010 (ATC)	N/A	5
VFDs at EFs & Pumps	260010	260010	260010	230010 (ATC)	N/A	6
Elevator Hoistway Vent Damper	230010	230010	N/A	N/A	N/A	
Elevator Hoistway Vent Damper Actuator	230010 (ATC)	230010 (ATC)	26 00 10	230010 (ATC)	26 00 10	
Boiler/DHW/ Intake & Exhaust Breeching	220000	220000	N/A	N/A	N/A	
Generator Exhaust Breeching	220000 (if gas fired) 220000 (if diesel fired)	220000 (if gas fired) 230010 (if diesel fired)	26 00 10	26 00 10	26 00 10	
Kitchen Emergency Gas Valve	220000	220000	26 00 10	26 00 10	26 00 10	

Notes:

1. Division 230010 and Division 230010 (ATC) Contractors shall fully coordinate all airflow damper and hydronic valves sizes and quantities.
2. Smoke Damper and VAV Box power wiring shall be provided by Division 26 00 10 to junction box locations shown on electrical drawings; Division 230010 (ATC) Contractor shall provide final power wiring from junction box to end device location.
3. Division 26 00 10 Contractor shall provide all line-voltage power wiring required for meters; Division 230010 (ATC) Contractor shall provide all low-voltage power wiring required for meters.
4. Division 26 00 10 shall provide power at main DDC Panel. Division 230010 (ATC) shall provide power to all other DDC Panels.
5. Power wiring for RTU, HV, MAU, AHU & ERV shall be a single point connector made by the Electrical Contractor (260010). Integral wiring and connections shall be provided by Division 230010.
6. Division 26 00 10 shall provide VFDs for all EFs and pumps with exception to EFs and/or pumps provided with ECM motors. ECM motors are specified in Division 230010 and provided by Division 230010 coordinate with mechanical schedules and specifications.

1.28 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – MEP Commissioning Requirements.

B. Complete installation and startup checks and functional tests according to Section 019113 – MEP Commissioning Requirements and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

A. GENERAL PROVISIONS

1. Commissioning Agent will be hired by the Electrical Subcontractor for Commissioning services outlined herein. Subcontractors responsible for items to be commissioned shall cooperate and coordinate with the Commissioning Agent and provide necessary information as outlined herein.
2. All of the Contract Documents, including Drawings, Invitation for Bids and Division 1 - General Requirements, apply to the Work of this Section.
3. Carefully examine all of the Contract Documents for requirements which affect the Work of this Section. The exact scope of Work of this Section cannot be determined without a thorough review of all specification Sections and other Contract Documents.
4. Commissioned systems shall be documented and functional performance tests verified with facility staff participating with on-the-job training, when available, during the functional performance testing.
5. Reference shall be made to the following sections:

    a. Section 017700: Closeout Procedures
    b. Section 230548: Vibration Control and Seismic Restraint

B. SYSTEMS TO BE COMMISSIONED

1. Exterior lighting
2. Standby Electrical System.
3. Daylight Controls
4. Light sweep controls
5. Occupancy Sensors

C. COMMISSIONING TEAM

1. The Commissioning Team shall consist of representatives from the following parties involved in the design and construction of this facility:

    a. Facility Manager/Owner Representative
    b. Commissioning Firm
    c. Electrical Design Team Representatives
    d. Electrical Contractor Representatives
    e. Testing Contractor

D. COMMISIONING DOCUMENTATION

1. Commissioning Documentation shall include the following:

    a. Commissioning meeting minutes shall be by the Commissioning Agent for documenting regularly scheduled meeting discussions, responsibilities and action agenda due dates.
    b. Pending issues log for documenting issues identified and/or commissioning activities that are deferred and/or seasonal functional performance tests.
    c. Maintain current shop drawing log for documenting equipment submittals to be commissioned and associated O&M requirements.
    d. Utilize static and operational performance test sheets for documentation of system(s) to be commissioned.
    e. Corrective action log for documenting performance test deficiencies found during the performance testing. Each corrective action shall require a re-test of that deficiency to demonstrate compliance.
    f. Equipment & System Training Log for documenting Contractor required training of Owner personnel.

E. COMMISSIONING GOALS

1. The goals of the commissioning process are as follows:

    a. Certification that all noted systems meet the requirements set forth in the design documents for all systems and equipment noted.
    b. To provide a comprehensive, Commissioning Plan
    c. Provide a Commissioning Plan which defines the trade contractors' responsibilities as part of the commissioning process.
    d. Demonstration of performance of systems commissioned.
    e. Successful project closeout and warranty transition.

F. SCHEDULING OF ACCEPTANCE TESTING WORK

1. Static Review: Check procedures shall be conducted immediately after notification that the work of various systems and equipment is installed and the installing contractor has confirmed compliance with the contract documents.

2. Operational Performance Testing procedures shall be conducted immediately after notification that the work of the various systems and equipment is operational and that the installing contractor has completed his own tests to confirm compliance with the contract documents.

G. DOCUMENTATION

1. Prior to the conducting of static and operational testing procedures, the Commissioning Agent shall obtain the following:

   a. Project Plans and Specifications including revisions made by addenda, approved alternates, Requests for Information (RFI) and change orders.
   b. Approved submittals.

H. CONTRACTOR RESPONSIBILITIES

1. Electrical Contractor

   a. The contractor shall be present as requested by the Commissioning Agent during the acceptance testing procedures of their respective systems and equipment.

2. General Contractor

   a. The General Contractor shall verify completeness of the building envelope, which may effect proper operation and control of Electrical equipment and systems.

3. Owner

   a. The Owner shall assign maintenance personnel to participate in the commissioning process. The purpose shall be to become familiar with all tested systems as well as instruction on operation and maintenance.

I. FINAL ACCEPTANCE

1. When all noted systems are found to be operating satisfactorily in accordance with the plans and specifications, then the final commissioning report documenting satisfactory performance shall be prepared and submitted for review and approval.
2. After approval a copy of the commissioning plan and test results shall be included with each copy of the Operations and Maintenance Manuals.

J. ACCEPTANCE PROCEDURES

1. The agent-provided static and operational checklists shall be used to document the results of the testing process.
2. The performance testing process shall be accomplished for all equipment, subsystems, etc. listed in the approved commissioning plan. Complete a checklist for each piece of equipment and/or system noted to ensure documentation specific to each is complete.
3. Acceptance testing of all devices shall be performed by actual observations of the controlled devices such as photo sensors, occupancy sensors, switches, computer interface, or other remote or indirect method is not acceptable.
4. Functional performance testing shall progress from components to equipment to subsystems to complete systems, in order to identify and correct the root causes of problems before their effect on an entire system is observed. Submit all deficiencies to be corrected to the contractors for immediate correction.

5. At the end of the process, every system and all equipment, shall have been proven operational under all normal operational modes, including part and full load, and under abnormal or emergency conditions.
6. Testing shall be accomplished on each control device. All relays and adapters shall be checked for proper operation. All system interlocks, interconnections, and safety devices shall be checked for proper function.
7. Simulate temporary upsets of systems, such as distribution fault, control loss, setpoint change, and component failure, at different operating loads to determine system stability and recovery time.

K. VERIFICATION AND DOCUMENTATION

1. As each individual check or test is accomplished, the Commissioning Agent shall observe the physical responses of the system and compare them to the specified requirements to verify the test results. The actual physical responses of system components shall be observed. Reliance on control signals or other indirect indicators are not allowed. Observe the input and output signals for each control component to confirm correct actions and indication for each physical condition.
2. Verification of the testing shall be an integral part of commissioning testing.
3. The Commissioning Agent shall record the results of each individual check or test on pre-approved test and report form from the commissioning plan.
4. If any check or test cannot be accomplished for seasonal reasons, lack of occupancy, or for other reasons, this fact shall be noted along with an indication of when the test shall be scheduled.
5. If any check or test cannot be accomplished due to building structure or other building system deficiencies these deficiencies shall be resolved and corrected by the appropriate parties before completion of the commissioning process.
6. Every check or test for which acceptable performance was not achieved shall be repeated after the necessary corrective measures have been completed. This re-testing process shall be repeated until acceptable performance is achieved.

L. CORRECTIVE MEASURES

1. If acceptable performance cannot be achieved, then the design professional representative and the electrical contractor shall be notified.
2. If inadequate performance is due to equipment deficiencies, then the appropriate contractor shall work with the equipment manufacturer to resolve the problem.
3. If the inadequate performance is due to design deficiencies, then the design professional shall issue appropriate directions to implement the necessary corrective measures

M. INTERSYSTEM FUNCTIONAL PERFORMANCE TESTS

1. When all individual systems' functional performance has been proved, the interface or coordinated responses between systems shall be checked. The systems involved may be within the overall Electrical work, or they may involve other systems, such as HVAC and plumbing systems.
2. The approach to intersystem performance testing shall follow that previously described for systems.
3. Acceptance testing shall not be started on any system until it is documented to be complete by the contractor and/or his subcontractors. If all systems are not fully complete, but some are complete, it is permissible to acceptance test the completed systems first and continue with other systems after they have been completed.

N. Sample Functional Review checklist:

1. Exterior Lighting

Exterior Lighting Controls - Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Electrical contractor sign off by:_____			
Prerequsite	All control system functions for this and all interlocking systems are programme	☐	☐	☐
	and operable per contract documents, including final setpoints, schedules, debugging and fine tuning of photo-cell parameters.			
	All A/E punchlist items for this equipment corrected.	☐	☐	☐
	Safeties and operating ranges reviewed.	☐	☐	☐
	Test requirements and sequences of operation attached.	☐	☐	☐
	Schedules and setpoints attached.	☐	☐	☐
	Have all energy savings control strategies, setpoints and schedules	☐	☐	☐
	been incorporated that this equipment and control system are capable of? If not, list recommendations below.			
	Review the EMS software control program(s) for	☐	☐	☐
	this equipment. Parameters, setpoints and logic sequences appear to follow the specified written sequences.			
	Schedule of fixtures on each control type (Parking or Security) has been reviewe	☐	☐	☐
	Record of All Values for Current Setpoints (SP), Control Parameters, Limits,	☐	☐	☐
	Delays, Lockouts, Schedules, Etc. Changed to Accommodate Testing:			
Parameter	Parking lot lights ON by photo cell	☐	☐	☐
	Parking lot lights OFF by photo-cell	☐	☐	☐
	Exterior security lights ON by photo cell	☐	☐	☐
	Exterior security lights OFF by photo-cell	☐	☐	☐
	Photo-cell BAS parameters	☐	☐	☐
Inspection-Verification Equipment Installation	Near dusk, observe exterior lights until they come ON.	☐	☐	☐
	All exterior lights come on at dusk, before dark, but not when still very light.	☐	☐	☐
	Change the Parking Lot light schedule OFF to be in 5 minutes.	☐	☐	☐
	Observe that the parking lot lights, designated by the approved schedule,	☐	☐	☐
	shut OFF. Designated signage remains ON.			
	Before daylight in the morning, observe the security lights ON. Wait until daw	☐	☐	☐
	When sufficiently light, Security Lights and signage lights shut OFF.	☐	☐	☐
	Return all changed control parameters and conditions to their pre-test values.	☐	☐	☐
	Record any permanently changed parameter values and submit to Owner.			
	Electrical contractor sign-off by:_____			
Equipment Manufacturer Verification	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Training of owner complete	☐	☐	☐
	Manufacturer sign off by:_____			

2. Standby Electrical System

Standby Electrical System - Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Electrical contractor sign off by:_____			
Prerequsite	Started up and startup reports and prefunctional checklists submitted			
	Emergency generator and ATS	☐	☐	☐
	UPS	☐	☐	☐
	All control system functions for this and all interlocking systems are programmed and operable per contract documents	☐	☐	☐
	All A/E punchlist items for this equipment corrected.	☐	☐	☐
	These functional test procedures reviewed and approved by installing contractor and vendors.	☐	☐	☐
	Safeties and operating ranges reviewed.	☐	☐	☐
	Test requirements and sequences of operation attached.	☐	☐	☐
	Verify that generator gages and meters for voltage, amperage and frequency are calibrated to hand-held or load profiler instrument readings.	☐	☐	☐
	Monitoring security company notified of test. Arrangements made to test UPS loads and load bank	☐	☐	☐
	Electrical contractor sign off by:_____			
Initial Procedures	Verify that power has been lost from each load served by emerg. power.	☐	☐	☐
Generator, ATS and Loads	Power Line Disturbance Monitor to monitor the transient responses.			
	Compare to specifications.	☐	☐	☐
	Time delay from power failure to engine start signal should be within	☐	☐	☐
	Actual_____sec., Expected_____sec.	☐	☐	☐
	Cranking time until prime-mover starts and runs should be within			
	Actual_____sec., Expected_____sec.	☐	☐	☐
	Time until engine-generator is at proper voltage and frequency			
	Actual_____sec., Expected_____sec.	☐	☐	☐
	Total time from power failure until ATS switch is on E-power			
	Actual_____sec., Expected_____sec.	☐	☐	☐
	Delay to normal power			
	Actual_____min., Expected_____min.	☐	☐	☐
	Neutral delay time			
	Actual_____min., Expected_____min.	☐	☐	☐
	Cool down time			
	Actual_____min., Expected_____min.	☐	☐	☐
	Electrical contractor sign off by:_____			
Full Load Test	Delay to normal power			
	Actual_____min., Expected_____min.	☐	☐	☐
	Neutral delay time			
	Actual_____min., Expected_____min.	☐	☐	☐
	Cool down time			
	Actual_____min., Expected_____min.	☐	☐	☐
	Electrical contractor sign off by:_____			
Step Load Tests	Specified frequency regulation range = +/-_____Hz	☐	☐	☐
	Specified voltage regulation range = +/-_____V	☐	☐	☐
	Verify there are no significant variations in temperature between phases	☐	☐	☐
	Verify that generator starts and E-power sequence initiated	☐	☐	☐
	Verify alarms are generatred and E-power system goes or remains off-line	☐	☐	☐
	Verify all alarms are properly annunciated in the remote panel	☐	☐	☐
	Verify alarm received by EMS and remote sites	☐	☐	☐
	ATS values			
	Hz Actual_____, Expected_____	☐	☐	☐
	Amps Actual_____, Expected_____	☐	☐	☐
	Volts Actual_____, Expected_____	☐	☐	☐

Standby Electrical System - Operational Performance Test

		PASS	FAIL	N/A
UPS	Observe the generator start and ATS switch to generator power	☐	☐	☐
	Verify UPS goes back to generator power per spec	☐	☐	☐
	Verify that specified voltage dynamic regulation is met:			
	Actual_____, Expected_____	☐	☐	☐
	Steady-state voltage			
	Actual_____, Expected_____	☐	☐	☐
	Frequency overshoot			
	Actual_____, Expected_____	☐	☐	☐
	Verify that THD less that 5%	☐	☐	☐
	Verify that wave form deviation is minimal	☐	☐	☐
	Verify amperage of each phase off the UPS is balanced			
	Phase A = _____	☐	☐	☐
	Phase B = _____	☐	☐	☐
	Phase C = _____	☐	☐	☐
	Phase imbalance is within _____			
	Verify that UPS is tuned	☐	☐	☐
	Verify all alarms are properly annunciated	☐	☐	☐
	Verify that loaded UPS provides sufficient power	☐	☐	☐
	Verify that UPS is charging properly from the generator	☐	☐	☐
	Verify function of UPS bypasses	☐	☐	☐
	Check calibration of UPS digital readouts of frequency, current and volts			
	Hz Actual_____, Expected_____	☐	☐	☐
	Amps Actual_____, Expected_____	☐	☐	☐
	Volts Actual_____, Expected_____	☐	☐	☐
Building Test	Verify generator is running at less than 100% load, Actual _____	☐	☐	☐
	Verify that proper power is delivered to each device listed in emergency			
	panel schedules and that equipment directly worded functions properly	☐	☐	☐
	Verify all emergency lighing is on as specified	☐	☐	☐
	All loads are properly servied with power	☐	☐	☐
	Verify that specialty emergency lighing is on using emergency panel service	☐	☐	☐
	All loads are properly servied with power	☐	☐	☐
	Verify proper power at each emergency power receptacle	☐	☐	☐
	Verify proper fucntion of specialty load on emergency power			
	Security panel	☐	☐	☐
	Fire alarm panel	☐	☐	☐
	Telecom system	☐	☐	☐
	Elevator	☐	☐	☐
	UPS monitored alarms			
	Electrical failure	☐	☐	☐
	Detection of power being switched to UPS	☐	☐	☐
	Low battery	☐	☐	☐
	Space temperature above alarm setpoint	☐	☐	☐
Inspection-Verification Equipment Installation	Installation on housekeeping pad	☐	☐	☐
	Equipment per contract documents/details/shop drawing	☐	☐	☐
	Drain piping installation completed	☐	☐	☐
	Vent piping installation completed	☐	☐	☐
	Noise level and/or vibration acceptable	☐	☐	☐
	Equipment insulated	☐	☐	☐
	Equipment labeled	☐	☐	☐
	Equipment has been cleaned inside and out	☐	☐	☐
	Piping contractor sign-off by:_____			
	Insulation contractor sign off by:_____			
	Electrical contractor sign off by:_____			
Inspection-Verification Equipment Manufacturer	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Manufacturer sign off by:_____			

3. Daylighting Controls

Daylighting Controls - Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Electrical contractor sign off by:_____			
Lighting Zone Schedule	Verify that lighing zoning is in accordance with submittals	☐	☐	☐
Daylighting Control System	Verifty that the following are in accordance with submittals:			
	Luminaire control	☐	☐	☐
	Design illuminance setpoint	☐	☐	☐
	Work plane for application	☐	☐	☐
	Lighting control zone per each perimeter exposure on each floor	☐	☐	☐
	Controls were calibrated as part of system start-up	☐	☐	☐
	Calibration was done with finishings and furniture in place	☐	☐	☐
	Daylighting control type	☐	☐	☐
	Occupants have been explained the intent and operation of control:	☐	☐	☐
Nameplate Data	Verifty that the following are in accordance with submittals:	☐	☐	☐
	Photosensor	☐	☐	☐
	Lighting controller	☐	☐	☐
	Controlled Ballasts	☐	☐	☐
Inspection-Verification Equipment Installation	Verify that lighting zone generally correlates with area of daylight availability	☐	☐	☐
	Verify that there is separate control of luminaries close to and far from the windows	☐	☐	☐
	Verifty that photosensor is mounted in proper location	☐	☐	☐
	Verify that photosensor is protected from direct sunlight	☐	☐	☐
	If indeirect lighting is used, verify that photosensor is mounted at lower plane of fixture, facing down	☐	☐	☐
	Verify that interior finishes and work space location are consistent with efficient use of daylighting	☐	☐	☐
	Verify that skylights and other toplighting glazing clean	☐	☐	☐
	Verify that all almps in lighting zone dim to approximately the same level	☐	☐	☐
Inspection-Verification Equipment Manufacturer	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Manufacturer sign off by:_____			

4. Lighting Sweep Controls

Lighting Sweep Controls - Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Electrical contractor sign off by:_____			
Lighting Zone Schedule	Verifty that the following are in accordance with submittals:			
	Interior corridor	☐	☐	☐
	Gymnasium	☐	☐	☐
	Auditorium	☐	☐	☐
	Cafeteria	☐	☐	☐
	Site Lighting	☐	☐	☐
	Administration Area	☐	☐	☐
	Control contractor sign off by:_____			
Inspection-Verification Equipment Installation	Verify that lighting scheduels are programmable with a micro-processor-based central processing unit	☐	☐	☐
	Verify that CPU allows separate weekday, weekend, & holiday sch.	☐	☐	☐
	Verify battery backup	☐	☐	☐
	Verify that zone is less than 2500ft sq. in area	☐	☐	☐
	Verify method of override	☐	☐	☐
	Verify override method is compatible with CPU	☐	☐	☐
	Verify override is located within general area of zone (s) controlled	☐	☐	☐
	Verify that the system provides warning to occupants prior to lights being swept off	☐	☐	☐
	Verify that schedule & override time period are reasonable for zone	☐	☐	☐
	Verify that occupants have been explained that intent & operation of the sweep system	☐	☐	☐
Performance Verification	Verify lights in zone are turned off at scheduled time	☐	☐	☐
	Verify lighting sweep is preceded by occupant warning (blinking of lights, etc.)	☐	☐	☐
	Verify override turns on zone lights only	☐	☐	☐
	Verify lights turned on by override are turned off after programmed override period	☐	☐	☐
	Verify if space has split wiring, inboard and outboard lights are properly sequenced	☐	☐	☐
	Verify if there is a keyed whole floor switch (for cleaning staff, etc.) this is also swept off	☐	☐	☐
Inspection-Verification Equipment Manufacturer	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Owner's training complete	☐	☐	☐
	Manufacturer sign off by:_____			

5. Occupancy Sensor

Occupancy Sensor - Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Electrical contractor sign off by:_____	☐	☐	☐
Inspection-Verification Equipment Installation	Verify sensor type	☐	☐	☐
	Verify wattage of controlled light fixture	☐	☐	☐
	Veirfy sensor wattage capacity is adequate for lights to be controlled	☐	☐	☐
	Verify unit mounted per manufacturer's requirements	☐	☐	☐
	Verify emergency lighting, uncontrolled by occ. sensor, in controlled space	☐	☐	☐
	Verify all occupant area in the controlled space is line-of-sight to sensor	☐	☐	☐
	Verify sensor not mounte idn location that could be temporarily blocked from detecation pattern (e.g. behind door)	☐	☐	☐
	Verify PIR sensors: mounted >4 feet from HVAC vents & heat sources	☐	☐	☐
	Verify PIR sensors: all occupant area in the controlled space is <20 feet from sensor, or per manufacturer's recommendation	☐	☐	☐
	Verify ultrasonic sensors: all occupant area in the controlled space in <30 feet from sensor, or per manufacturer's recommendation	☐	☐	☐
	Verify sensor not mounted such that it detects motion in space outside controlled space	☐	☐	☐
	Verify (if required) sensitivity range exceeds sensor range.	☐	☐	☐
	Verify that mask is adjusted to match controlled space	☐	☐	☐
	Verify time delay (time-to-off) setting (20 min. unless specified diff.)	☐	☐	☐
	Verify sensitivity settings for each area, entry, etc.	☐	☐	☐
	Electrical contractor sign off by:_____			
	Installation contractor sign off by:_____			
Performance Verification	Verify sensor type	☐	☐	☐
	Verify slight hand movement in center of occupied space turns on lights	☐	☐	☐
	Verify slight hand movement at periphery of occupied space turns on lights	☐	☐	☐
	Verify adjusted test time-to-off delay	☐	☐	☐
	Verify after occupied space is vacated, lights turn off after ___mins	☐	☐	☐
	Verify that walking past door doe not turn on lights	☐	☐	☐
Inspection-Verification Equipment Manufacturer	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Owner's training complete	☐	☐	☐
	Manufacturer sign off by:_____			

PART 2 - PRODUCTS

2.1 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 does 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.

2.2 RACEWAYS AND FITTINGS

A. Raceways - General:
1. No raceway shall be used smaller than ¾ in. diameter and shall have no more than four 90 deg. 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, and in mechanical rooms for drops down to equipment from elevations below eight feet and also where raceway may be subject to mechanical damage.
3. Intermediate metal conduit 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 may be used for fire alarm work.
5. Surface metal raceways conforming to, and installed in accordance with, Article 386 may be used only where raceways cannot be run concealed, and then, if only specifically approved.
6. 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.
7. Rigid non-metallic conduit may be used for underground electric and telephone services outside the foundation wall and also below slab and shall be polyvinyl chloride (PVC) schedule 40, 90 deg. C. Rigid metal conduits shall be used thru-foundation walls and thru-slab. Below slab conduits do not require concrete encasement.
8. PVC Schedule 40 may be used for below slab circuits within building confines. Below slab rigid non-metallic conduits do not require concrete encasement. Rigid non-metallic conduits may be used for below slab feeders and branch circuits, but shall not be used in slabs, nor for elbows which penetrate slabs. Raceways and fittings shall be produced by same manufacturer.
9. PVC schedule 40 may also be used for underground branch circuits outside the foundation wall.

10. PVC schedule EB conduit will be used as indicated on Electrical Site Plan, and where encased in concrete.
11. Acceptable manufacturers:
    a. Pittsburgh Standard Conduit Company
    b. Republic Steel and Tube
    c. Youngstown Sheet and Tube Company
    d. Carlon
    e. Or equal
12. 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. Bond separate buildings in accordance with code.
    d. Couplings for rigid metal and intermediate metal conduit shall be threaded type.
    e. Threadless fittings for EMT shall be watertight compression type 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.
        1) Acceptable manufacturers:
            a) O.Z.
            b) Crouse Hinds
            c) Appleton
            d) EFCOR
            e) Steel City
            f) Or equal

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 in. 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 in. 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 in. square or of comparable volume.
    c. Far side box supports shall be Caddy J-1A.
    d. Acceptable manufacturers:
        1) Appleton
        2) Crouse Hinds
        3) Steel City
        4) RACO
        5) Or equal

2. Pull and Junction Boxes: 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 sized per Code. Pencell fiberglass handholes are allowed as a substitute for Quazite handholes with H20 wheel load covers.
3. 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.
   a. Acceptable Manufacturers:
      1) Brasch
      2) Hoffman
      3) Keystone
      4) Lee Products Co.
      5) McKinstry Inc.
      6) Eldon Inc.
      7) Or equal

2.3 CONDUCTORS

C. 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 ft. at 120 volts and 150 ft. at 277 volts, #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
6.	Isolated Ground	120/208	Green with Orange Trace

D. All conductors not installed in accordance with color scheme shall be replaced. All conductors larger than #6 AWG must be identified with colored tape.

E. Comply with CMR 527, Massachusetts Electrical Code.

F. Comply with Underwriter's Laboratories (UL) standards:
1. UL 4: Armored Cable.
2. UL 62: Flexible Cord and Fixture Wire.
3. UL 83: Thermoplastic-Insulated Wires and Cables.
4. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
5. UL1569: Metal -Clad Cables.

G. Comply with NEMA WC-5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

H. 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:
      a. 3M "Scotchlock"
      b. IDEAL "Wingnut"
      c. BURNDY
      d. MAC
      e. Or equal
   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.

I. Conductors shall be copper, soft drawn, and annealed of 98 percent 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 degrees C) except as follows:
      a. In sizes #1 AWG and larger: Crosslinked polyethylene insulation type XHHW (75 degrees C – 90 degrees 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".

J. Stranded conductors for all wiring systems except fire alarm will be allowed if installed and terminated as specified under Execution Section.

K. Mineral-Insulated Metal-Sheathed Fire-Resistive Cables (Type MI) - Cables shall consist of a factory assembly of one or more solid copper conductors insulated with highly-compressed magnesium oxide and enclosed in a seamless, liquid-and-gas-tight continuous copper sheath. Cables shall be rated for 600 volts and less. Cables shall comply with Article 332 of the National Electrical Code. Cables shall be classified by Underwriters Laboratories, Inc. as having a 2-hour fire resistive rating. Cable terminations shall be made with UL listed mineral-insulated cable fittings. Approved Manufacturer - Pyrotenax USA, Inc. or approved equal.

L. Type MC Cable may be used for concealed branch circuits in hollow spaces where allowed by code if installed and terminated as specified under Execution Section. Armor shall be galvanized steel and shall be UL listed for 2 hour fire wall penetration. Aluminum armor is not acceptable.

M. Type MC Cable may also be used for fire alarm where concealed and allowed by Code. Armor shall be red.

N. Acceptable manufacturers:
   1. AFC Cable Systems
   2. American Wire & Cable
   3. Cerro
   4. Cornish
   5. Cresent
   6. General Cable
   7. Okonite
   8. Or equal

O. Installation of conductors and cables
1. Install all power and 120 volt control wire and cable in approved raceways. When low tension wiring is run exposed, install it in conduit. Plenum rated low tension cable may be used for installation above suspended ceilings where it is allowed by the Code and is allowed in the specification for the specific system.
    a. Wire Size:
        1) Install minimum No. 12 AWG for power and lighting circuits.
        2) Install minimum No. 10 AWG for 120 volt 20 ampere branch circuits of 75 feet to 150 feet length, and minimum No. 8 AWG for the circuits of 150 feet to 250 feet unless otherwise shown on the drawings or required by the equipment shop drawings.
        3) Install minimum No. 10 AWG for 277 volt 20 ampere branch circuits of more than 150 feet unless otherwise shown on the drawings.
2. Metal clad cable type MC may be used for branch circuit wiring above suspended ceilings and for device wiring in the metal stud partitions. MC cable shall not be used for a termination at the panels (homeruns) and where they run exposed. Any wiring associated with Smoke control systems cannot be installed in MC cable as it does not meet 780 CMR Section 909.12.1.
3. Bundle conductors #10 and smaller in branch circuit panelboards, signal cabinets, signal control boards in switchboards and motor control centers.
4. Homerun Circuits:
    a. Follow homerun circuit numbers shown on the drawings to connect circuits to the panelboards. Where homerun circuit numbers are not shown on the drawings, divide similar types of connected loads among phase busses so that currents in each phase are within 10% of each other during normal usage.
    b. Wire multi-wire branch circuit homerun with two or three single phase and one common neutral conductor to a panel in a such manner that each phase circuit is fed from the adjacent circuit breakers. Do not combine circuits so that any homerun has more than three circuits (total of five wires) installed in one conduit, unless the circuit conductors are de-rated in strict accordance with the referenced Electrical Code.
    c. Branch circuit wiring in the classrooms, laboratories and offices shall be provided with a dedicated neutral conductor for each phase conductor.
5. Properly group feeders, branch circuit and auxiliary system wiring passing through pull boxes and/or being made up in panelboards; neatly bind each group of wires together with plastic cable ties, and trim loose ends of the ties.
6. Peel branch circuits and auxiliary system wiring out of the wiring gutters at the terminal cabinet and panels at 90 degrees to circuit breakers and terminal lugs before making connections.
7. Color code conductors No. 6 AWG and larger by applying colored plastic tape at ends and where connections and splices are made. Wrap tape around the conductor three complete turns.
8. Splices and Terminations:
    a. Make splices and joints by means of UL-listed, solderless connectors rated 600 volt, of sizes and types required by manufacturer's recommendations, with temperature ratings equal to that of wire.
    b. Attach copper wire to panelboards, switchboards, disconnect switches and other electrical equipment by means of bolt-on lugs with hex screws. Properly size lugs; do not cut strands from a conductor in order to fit conductor into a lug.
    c. Connectors for cables 250 MCM and larger shall have two clamping elements and terminals for bus connections shall have two bolt holes.

9. Identification: Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems." Label feeder and branch circuits in pull and junction boxes, handholes and at cable terminations in the panelboards, motor control centers, and switchboards. Use non-ferrous tags or labels stamped or printed to correspond with markings on the drawings or marked so that feeder or cable may be identified readily. If suspended tags are provided, attach with nylon line or cable lacing.
10. Connect branch circuits to the breakers in multi-phase panelboards required to balance loads.
11. Provide handle ties for multiwire branch circuits as required in the NEC
12. Low Tension Cables: Provide separation from power wiring and lighting fixtures as follows:
    a. Lighting fixtures - at least 6 inches.
    b. Power branch circuit wiring with MC type cable - at least 12 inches.
    c. Power branch circuit wiring in metal conduit - at least 6 inches.
13. When low-tension cables are not in conduit or trays, support cables from the deck and/or beams, spacing supports no farther apart than 6 ft.-0 in. on center. Provide hangers, clips or other approved method of grouping the cables and keeping them away from other systems. Take care to ensure that ties, clips and other support devices do not compress the cable or damage cable insulation; use J-hooks whenever possible.
14. Cable Supports:
    a. Provide cable supports for vertical feeders required by the referenced Electrical Code.
    b. Support vertical feeders at each floor level.
    c. Support and secure metal-clad cable Type MC at intervals not exceeding 6 feet and within 12 inches from every outlet box, junction box or cabinet.
    d. Support metal clad cable Type MC with cable supports equal to Caddy WMX-6, MX-3, and clamps equal to Caddy 449. Where cables are supported by the structure and only need securing in place, then cable ties will be acceptable.
15. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
16. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
17. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
18. For wiring in high temperature areas or high temperature equipment (i.e. boiler rooms, water heaters/boosters), furnish conductors for 90°C dry and wet rating.

2.4 ACCESS PANELS

A. Coordinate and Furnish 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 in. x 12 in.). When access panels are required in corridors, lobbies, or other habitable areas, they shall be located as directed by the Architect. Submit layout and locations for approval.

C. Access panels once coordinated with the architect and the G.C. shall be furnished by this trade contractor to the G.C. for installation. Coordinate all locations so that the finish trades can locate the rough openings appropriately.

D. Furnish Access panels in compliance with Section 083110.

E. Furnish access panel shop drawings.

2.5 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 in. above finished floor. Core drilling will also be acceptable if in accordance with any structural standards. Any unsleeved 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 Trades Contractor so he may box out opening in form work.

D. Any openings through fire rated surfaces shall be closed off with fireproofing materials providing the same rating as the surface penetrated.

Manufacturers:

1. Specified Technologies Inc.
2. Thomas & Betts
3. International Protective Coatings Corp.
4. 3M Fire Protection Products
5. Or equal

2.6 FLOOR OUTLETS (FLUSH TYPE)

A. Section includes flush floor boxes equal to Wiremold RFB Series. Provide appropriate floor box model that meets the intent of what is shown on the drawings.

B. Quality Assurance

1. Electrical Raceways and Components: Comply with requirements of applicable local codes, NEC, UL, and NEMA Standards pertaining to raceways and components. Listed and labeled in accordance with NFPA 70, Article 100.

C. Floor Boxes

1. RFB4 and RFB4-4DB Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 12-3/4" L x 10" W x 3-7/16" H [324mm x 254mm x 87mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The RFB4 Series Box shall permit tunneling from end power compartment to end power compartment. The RFB4-4DB Series Box shall permit tunneling from adjacent or opposite compartments. Two (2) of the four (4) compartments shall have a minimum wiring capacity of 16.4 cu in [269cu cm], one (1) compartment shall have a minimum capacity of 32.3 cu in [529cu cm], and one (1) compartment shall have a minimum capacity of 50 cu in [820cu cm]. Four (4) compartments shall have a minimum of two (2) inches of space behind the device plates. The box shall include the following number of conduit knockouts: one (1) 1/2-inch [12.7mm], three (3) 1-inch [25mm], six (6) 3/4-inch [19.1mm], and six (6) 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-7/8-inch [47.7mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics® workstation

connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

2. RFB4-CI-1 and RFB4-CI-NA Series Floor Boxes: Manufactured from cast-iron and approved for use on grade and above grade floors. The box shall be 14-1/2" L x 11-7/8" W x 3-7/16" H [368mm x 302mm x 87mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles and/or communication services. The box shall permit tunneling from adjacent or opposite compartments. Two (2) of the four (4) compartments shall have a minimum wiring capacity of 27 cu in [443cu cm], and two (2) compartments shall have a minimum wiring capacity of 36 cu in [590cu cm]. Four (4) compartments shall have a minimum of two (2) inches of space behind the device plates. The box shall include the following number of conduit hubs: four (4) 1-inch [25mm] and four (4) 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-7/8-inch [48mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics® workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.
3. RFB4-SS Series Floor Boxes: Manufactured from stamped-steel and approved for use on above grade floors. The box shall be 13-5/8" L x 10" W x 2-7/16" H [346mm x 254mm x 62mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the four (4) compartments shall have a minimum wiring capacity of 15.7 cu in [257cu cm] and two (2) compartments shall have a minimum wiring capacity of 31.2 cu in [511cu cm]. Four (4) compartments shall have a minimum of two (2) inches of space behind the device plates. The box shall contain the following number of conduit knockouts: two (2) 1/2-inch [12.7mm], six (6) 3/4-inch [19.1mm], and eight (8) 1-inch [25mm]. The box shall be fully adjustable, providing a maximum of 1-7/8-inch [48mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics® workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.
4. RFB4E Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 13-1/8" L x 13-1/8" W x 4-1/16"" H [333mm x 333mm x 103mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The box shall permit feed through removable barriers from adjacent compartments. Four (4) compartments shall have a minimum wiring capacity of 75 cu in [1230cu cm]. Four (4) compartments shall have a minimum of 3-1/2 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: six 3/4-inch [19.1mm], ten (10) 1-inch [25mm], and eight (8) 1-1/4-inch [32mm]. The box shall have two removable knockout plates that can be replaced with a 2-inch trade size conduit hub (2HUB). The box shall be fully adjustable, providing a maximum of 2-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

5. RFB4E-OG Series Floor Boxes: Manufactured from stamped steel and painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and approved for use on grade and above grade floors. The box shall be 13-1/8" L x 13-1/8" W x 4-1/16" H [333mm x 333mm x 103mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The box shall permit feed through removable barriers from adjacent compartments. Four (4) compartments shall have a minimum wiring capacity of 75 cu in [1230cu cm]. Four (4) compartments shall have a minimum of 3-1/2 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: six 3/4-inch [19.1mm], ten (10) 1-inch [25mm], and eight (8) 1-1/4-inch [32mm]. The box shall have two removable knockout plates that can be replaced with a 2-inch trade size conduit hub (2HUB). The box shall be fully adjustable, providing a maximum of 2-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.
6. RFB6 Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 3-1/4" H [333mm x 317mm x 83mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.
7. RFB6-OG Series Floor Boxes: Manufactured from stamped steel and painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and approved for use on grade and above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 3-1/4" H [333mm x 317mm x 83mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment.
   The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.
8. RFB6E Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 4" H [333mm x 317mm x

102mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments through 1-1/4-inch grommet openings. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

9. RFB6E-OG Series Floor Boxes: Manufactured from stamped steel and painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and approved for use on grade and above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 4" H [333mm x 317mm x 102mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates, and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

D. Activation Covers

1. FloorPort FPCT, FPBT, and FPFFT Series Covers: Manufactured of die-cast aluminum or die-cast zinc, and available in brushed aluminum finish and powder-coated paint finishes (black, gray, bronze, nickel and brass). Activation covers shall be available in flanged and flangeless versions. Covers shall be available with options for tile or carpet inserts, or flush covers. The cover's hinge shall allow for the cover to open 180 degrees. The furniture feed covers shall come equipped with one (1) 1-inch trade size screw plug opening and one (1) combination 1-1/4-inch and 2-inch trade size screw plug.

   a. Flanged covers shall be 7-3/4" L x 6-9/16" W [197mm x 167mm].
   b. Flangeless covers shall be 6-3/4" L x 5-9/16" W [171mm x 142mm].

2. 6CT, 6CTC, 6CFFTC, 8CTC, and 8CT Series Covers: Manufactured of die-cast aluminum alloy and available in powder-coated gray, black, brass, nickel or bronze finish. The covers shall be available in carpet and tile versions. Provide covers with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub water tightness. The activation cover for the 8CTC and 8CT series shall be 9-1/4-inch [235mm] in diameter. The activation cover for the 6CT and 6CTC series shall be 7-1/4-inch [184mm] in diameter and the activation cover for the 6CFFTC series shall be 7-3/4-inch [197mm] in diameter. The carpet covers shall be surface mounted and the tile covers shall be flush with the finished floor covering. The covers shall have spring loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.
3. The covers shall have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors.

E. Communication Modules Mounting Accessories

1. The floor box manufacturer shall provide a complete line of faceplates and bezels to facilitate mounting of UTP, STP (150 ohm), fiber optic, coaxial, and communication devices. The box shall provide a series of device mounting plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, and other open system devices.

F. Installation

1. Strictly comply with manufacturer's installation instructions and recommendations and approved shop drawings. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.
2. Mechanical Security: Raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, device mounting brackets, and cabinets, in accordance with manufacturer’s installation sheets.
3. Accessories: Provide accessories as required for a complete installation, including insulated bushings and inserts where required by manufacturer.
4. Unused Openings: Close unused box openings using manufacturer's recommended accessories.
5. Provide a minimum concrete pour depth of 3-7/16-inch [87mm] plus 1/16-inch [1.6mm] above the top of the box for the RFB4, RFB4-4DB, RFB2, and the RFB2-OG Series Boxes; 2-7/16-inch [62mm] plus 1/16-inch [1.6mm] for the RFB4-SS and RFB2-SS Series Boxes; and 3-7/16-inch [87mm] plus 13/16-inch [21mm] above the top of the box for the RFB4-CI-1, RFB6, and RFB6-OG Series Boxes; and 4-1/16-inch [103mm] above the top of the RFB4E and RFB4E-OG Series Boxes; and 4-inch [102mm] above the top of the RFB6E and RFB6E-OG Series Boxes. Provide the box with four (4) locations to accommodate leveling for pre-concrete pour adjustment and include four (4) leveling screws for the pre-pour adjustment.

P. Poke-Through Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hubbell.
   b. Pass & Seymour.
   c. Thomas & Betts Corporation.
   d. Wiremold
   e. Or equal

2. Poke-Thru Assembly
   a. Floor Fitting

1) The floor fitting shall consist of an insert and an activation cover. Floor fitting shall accommodate power and communications services in a single unit. Floor fitting shall have one ¾ in. trade size channel for power and one 2" trade size channel for communication cabling. Floor fitting shall consist of intumescent fire stop material to maintain the fire rating of the floor slab and UL Listed with a fire rating of 1, 1½, & 2 hours in an unprotected reinforced concrete floor or a 1 or 2 hour rating in floors employing steel floor units and concrete topping. The floor fitting shall be suitable in concrete floor thicknesses of 2.5 in. or greater. The insert shall have 12 installation barbs that will hold the poke-thru device in the floor slab without additional fasteners.

b. Insert Body
1) The insert body shall allow the devices to be recessed 3.5-inches, or 2.25-inches with the use of 1 ¼ in. supplied stand-offs. There shall be complete separation of channels allowing for individual separation of power and communications services. There shall be one channel arranged such that communication cables can be conduit protected and connected with a 2-inch trade size openings to accept both rigid and flexible conduit connectors. The inserts shall consist of multiple compartments that allow for up to 2 duplex receptacles that can be wired in configurations including standard receptacles, isolated ground or up to 12 communication ports.

c. Activation Cover/ Flange Assembly
1) Activation covers and Flange shall be manufactured of die-cast aluminum alloy and be capable of being plated in brushed brass, satin nickel, and bronze finish, lacquer coated brushed aluminum or powder-coated in , black, finishes. Flange shall be suitable for either carpet, tile, terrazzo and wood covered floors. Flange shall include a gasket adhered to the top inside surface to maintain scrub water tightness with sub plates. Flange shall include a gasket for assembly against the floor to maintain scrub water tightness. Cover assembly shall provide a single hinged access doors that rotate 180 degrees flush with flange and incorporate foam gaskets to maintain scrub water tightness by preventing water, dirt, and debris from entering the power and communication compartment. Cover assembly shall feature cable access doors which secure to the underside of the closed cover that allow each cable access door to be opened and closed independently

d. Communication Modules Mounting Accessories
1) The poke-through manufacture shall have available modular inserts to facilitate mounting UTP (including Category 5, 5e, 6, 6a), STP, fiber optic, coaxial, and data/communications devices. The S1R6 series shall accommodate Extron MAAP or Extron AAP adapter plates. Where indicated provide connectivity outlets and modular inserts by Hubbell or approved equal.

Q. FURNITURE FEED POKE-THRU DEVICES
1. Poke-Through Assemblies:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Hubbell.
2) Pass & Seymour.
3) Thomas & Betts Corporation.
4) Wiremold
5) Or equal
2. Classification and Use: Furniture feed poke-thru devices shall have been examined and tested by Underwriters Laboratories Inc. to meet UL514A and/or UL514C and Canadian Standard C22.2, No. 18-98 and bear the U.S. and Canadian UL Listing Mark. Furniture poke-thru devices shall also have been tested by Underwriters Laboratories Inc. and

Classified for fire resistance and bear the U.S. and Canadian UL Classification Mark. Poke-thru devices are approved for use in recessed and flush floor construction and meet and exceed the UL scrub water exclusion test.

a. Devices shall be classified for use in 1-, 1-1/2-, or 2-hour rated, unprotected reinforced concrete floors and 1-, 1-1/2-, or 2-hour rated floors employing unprotected steel floor units and concrete toppings (D900 Series designs), or concrete floors with suspended ceilings. Fire resistive designs with suspended ceilings shall have provisions for accessibility in the ceiling below the poke-thru fittings.
b. These devices are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids such as commercial kitchens.
c. Floor boxes shall be suitable for use in air handling spaces in accordance with Section 300-22(c) of the National Electrical Code.

3. MATERIALS
   a. RC7AFFTC Flush Furniture Feed Poke-Thru Assembly for power: Consists of an insert and activation cover. Overall poke-thru assembly length shall be 16-1/2 in. [419mm].
      1) Insert: Insert body shall have the necessary channels to provide complete separation of power and communication services. There shall be one 3/4-inch trade size channel for power and two 1/2-inch trade size channels for communication cabling. The channels shall be arranged such that communication cables can be conduit protected and connected to the insert body using a die-cast zinc conduit connector with two 1/2-inch trade size threaded openings to accept both rigid and flexible conduit connections.
         a) The body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and shall not have to be adjusted to maintain the fire rating of the unit and the floor slab. Insert shall have a spring-steel retaining ring that will hold the poke-thru device in the floor slab without additional fasteners. The poke-thru insert shall also consist of one 3/4-inch trade size conduit stub and one 1-1/2-inch trade size conduit stub that are connected to the insert body. There shall also be a 24.5 cu in [402ml] stamped steel junction box for wire splices and connections. The stamped steel junction box shall also contain the necessary means to electrically ground the poke-thru assembly.

2) Activation Cover: The activation cover shall provide three conduit openings to feed modular furniture applications and provide a flush appearance. The activation cover trim flange shall be one-piece and be manufactured of forged aluminum alloy and be capable of being powder coated or plated. Coated finish is to be textured, two-stage epoxy paint in gray or black. Activation cover trim flange shall also be available in a solid brass forging and a die cast brushed aluminum finish. Aluminum and brass finish shall be a brushed finish with a lacquer sealant. The activation cover shall be seven inches [178mm] in diameter. A gasket is attached to the underside of the trim flange assembly to maintain scrub water tightness by preventing water, dirt, and dust from entering the power and communication compartments.

a) The activation cover insert shall provide one 3/4-inch NPSM threaded opening for power and two 1/2-inch NPSM threaded openings for communication to feed modular furniture workstations. Each activation cover shall also be supplied with one 3/4-inch trade size and two 1/2-inch trade size threaded conduit connectors and one (/4-inch trade size and one 3/4-inch trade size and two 1/2-inch trade size conduit closure plugs.

b. RC9AM2TC Furniture Feed Poke-Thru Assembly for data: Consists of an insert and activation cover. Overall poke-thru assembly length shall be 10 inches [254mm].

1) Insert: There shall be one 2-inch trade size channel for all power or all communication cabling. The body will also consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and shall not have to be adjusted to maintain the fire rating of the unit and the floor slab. Insert shall have a spring-steel retaining ring that will hold the poke-thru device in the floor slab without additional fasteners.

2) Activation Cover: The activation cover shall be manufactured of aluminum die-cast alloy and consist of a trim flange and a hexagonal service head. The activation cover shall be capable of being powder coated or plated. Finish shall be textured, two-stage epoxy paint available in a gray or black finish. A gasket is attached to the underside of the activation cover trim flange to maintain scrub water tightness. Trim flange shall have a combination 1-1/4 in. - 2 in. trade size conduit opening and closure plugs. The trim flange shall be seven inches [178mm] in diameter. All power connections must be made in a junction box below (not supplied).

R. Cleaning and Protection

1. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
2. Protect boxes and fittings until acceptance.

2.7 WIRING DEVICES

A. Manufacturers:

1. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

a. Cooper Wiring Devices.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.
e. Or equal

B. Straight Blade Receptacles:

1. Duplex Receptacles: Comply with NEMA WD 1, NEMA WD 6 configuration NEMA5-20R, UL 498 and FS W-C-596. Specification grade industrial series, straight-blade, 2 pole 3 wire grounding type, back and side wired, nylon face, rated for 120 volts, 20 amperes. Hubbell No.5362 or equal. Hubbell No.5362WR or equal for weather-resistant listed receptacles. Receptacles that are controlled by an automatic control device shall be marked per NEC with the international power symbol. Provide as indicated on the drawings with one controlled face and split circuit hot tab equal to Hubbell BR20C1 series.
2. Ground fault interrupter (GFI) receptacles: Duplex receptacles conforming to UL 943, specification grade heavy duty, feed-through type, rated for 120 volt, 20 amperes, NEMA 5-20R, GFI Class "A" with a sensitivity to leakage 5 milliamps, weather-resistant and tamper-resistant listed. Hubbell No. GF20LA or equal.
3. Transient-Voltage Surge-Suppressor (TVSS) Receptacles: Duplex type, NEMA 5-20R configuration, with integral transient-voltage surge protection in a minimum of 3 modes: line-to-ground, line-to-neutral, and neutral-to-ground; listed as complying with UL 1449. Hubbell HBL5362SA or equal.
4. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Specification grade, straight-blade, 2 pole 3 wire grounding type, back and side wired. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. Listed as tamper-resistant with “T” marking. Hubbell BR20TR or equal.
5. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. Straight blade; equipment grounding contacts connected only to the green grounding screw terminal of the device, with inherent electrical isolation from mounting strap. Hubbell CR 5253IG or equal.
6. Duplex Receptacles with Integral USB jacks, 125 V, 20 A: Specification grade, straight-blade, 2 pole 3 wire grounding type, back and side wired. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. “USB” marking indicates USB receptacle duplex grounding type NEMA 5-20R equal to Hubbell MX20X2 or equal

C. All standard 15 and 20 ampere, 125 and 250 volt non-locking type receptacles located 5 ft. -6 in. or below within Auditorium, Gymnasium, Pre-schools and elementary school age classrooms, medical clinic areas, dental offices and any other areas that are listed in NEC 406.12 shall be tamper resistant type receptacles whether indicated or not by the “T” marking on the drawings.

D. Exterior Outlets with Lockable Covers:

1. Provide exterior outlets with lockable covers at all exterior outlet locations. Provide GFCI Circuit Breakers on all branch circuits. Provide in-use weatherproof locking covers with cord retention. Provde Taymac MX3200 for single gang vertical MX3300 for single gang horizontal and MX6200 for double duplex.

    a. Equal manufacturers

        1) RACO
        2) Hubbell
        3) Or equal

E. Hazardous (Classified) Location Receptacles:

1. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cooper Crouse-Hinds.
2) Appleton Electric.
3) Hubbell.
4) KH Industries.
5) Or equal

F. Twist-Locking Receptacles:

1. Single Convenience Receptacles, 125 V and 250 V, 20 A: Comply with NEMA WD 1, NEMA WD6 and UL 498. Hubbell HBL2310 (L5-20R), HBL2320 (L6-20R), or equal.

G. Cord Reels

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell.
b. Cooper Crouse-Hinds.
c. Appleton Electric.
d. KH Industries.

2. Industrial grade retractable power cord reel with the following features:

a. Cast Aluminum construction, including mounting base
b. 12 position adjustable guide arm
c. Adjustable ratchet can be engaged (positive lock) or disengaged (constant tension) as needed
d. Adjustable ball stop
e. 6’ Feeder Cord included
f. White powder-coat finish
g. Universal mounting overhead, wall or detached from bracket completely.
h. Adjustable cable stop.
i. Voltage 125 VAC
j. Slip Ring Rating 600V/30A
k. Payout End Blk Duplex/Duplex Outlet Box
l. Feeder End 5-20P
m. Max. Amperage 20 Amps
n. Gauge/Conductor 12/3
o. Cord Length 25 Feet
p. Mounting Bracket with 340 deg. pivot base.
q. Cord Type/Color SJO/White Cord Reel
r. Color White
s. Hubbell Model#HBLI25123GF220M1 or equal.

3. For WP Cord Reel provide as follows:

    a. Hubbell Model#HBLW25123 or equal.
    b. Hubbell Model#HBLPOB1 receptacle enclosure
    c. Install two duplex receptacles in receptacle enclosure.
    d. Provide GFCI type circuit breaker for all WP Cord Reels

H. Snap Switches:

1. Comply with NEMA WD 1 and UL 20.
2. Switches, heavy duty, side wired, 120/277V, 20A:
3. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way).
    b. Hubbell; C1221 (single pole), C1222 (two pole), C1223 (three way).
    c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way).
    d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way).

I. Securely fasten wiring devices in place, plumb, level, and true to finished lines and surfaces.

J. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

K. Provide gaskets on all wiring device plates where devices are on walls separating conditioned and non-conditioned spaces and exterior walls.

L. Composition material of wiring devices to be nylon with ivory finish. Outlets intended for computer use shall be grey finish, outlets on emergency shall be red finish.

M. Wall Plates:

1. Single and combination types to match corresponding wiring devices.

    a. Plate-Securing Screws: Metal with head color to match plate finish.
    b. Material for Finished Spaces: White- finish Type 302 stainless steel.
    c. Material for Finished Spaces installed in concrete: Satin-finished Type 302 stainless steel.
    d. Material for Unfinished Spaces: Galvanized steel**.**
    e. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant**,** die-cast aluminum.

N. Finishes:

1. Color: Wiring device catalog numbers as specified do not designate device color.

    a. Wiring Devices Connected to Normal Power System: Grey for computer circuits white for convenience receptacles other devices as selected by Architect, unless otherwise indicated or required by referenced Electrical Code or device listing.
    b. Wiring Devices Connected to Emergency Power System: Red.
    c. Isolated-Ground Receptacles: Orange.

2.8 LIGHTING FIXTURES

A. General

1. Submit the following in accordance with project submittal procedures:

   a. Catalog Data: Submit catalog data describing luminaires, lamps, and ballasts. Include data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of fixture designation.
   b. Performance Curves/Data:

      1) Submit certified photometric data for each type of luminaire.
      2) Submit supply-air, return-air, heat-removal, and sound performance data for air handling luminaires.

   c. Drawings: Submit shop drawings for non-standard luminaires.
   d. Calculations: Submit as requested to support equal product proposals.
   e. Warranty: Submit warranties for luminaires and for electronic ballasts.

2. All lamps, ballasts, led sources, drivers, and controls shall meet the latest utility company incentive requirements. Refer to the latest program requirements documentation and coordinate with the utility company to ensure compliance.

B. Quality Assurance

1. Comply with the National Electrical Code (NEC) and the Massachusetts Building Code (MBC) for components and installation.
2. Provide luminaires listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environments in which installed.
3. Use manufacturers that are experienced in manufacturing luminaires, lamps and ballasts similar to those indicated for this Project and have a record of successful in-service performance.
4. Coordinate luminaires, mounting hardware and trim with the ceiling system.

C. Lamps

1. Furnish lamps that comply with requirements specified below and the luminaire schedule on the Drawings.

D. LED Assemblies

1. LED luminaires shall conform to UL 1598 and to UL 8250 – Safety Standard for Light-Emitting Diode (LED) Light Sources for Use in Lighting Products.
2. Products shall be lead and mercury free.
3. Photometric characteristics shall be established using IESNA LM-79-08, IESNA Approved Method for the Electrical and Photometric Measurement of Solid-State Lighting Products.
4. Color characteristics of LED luminaires shall be as follows in accordance with ANSI C78.377 – Specifications for the Chromaticity of Solid State Lighting Products.
5. LED and driver cooling system shall be passive and shall resist the buildup of debris.
6. LED luminaire output after 50,000 hours of operation shall be not less than 70 percent of the initial lumen output when determined in accordance with IESNA LM-80-08 – IESNA approved Method for Measuring Lumen Maintenance of LED Lighting Sources.

7. LED source package electrical characteristics:

    a. Supply voltage: 120 V, 208 V, 240 V, 277 V, or 480 V as indicated on the Drawings. Provide step-down transformers if required to match driver input voltage rating.
    b. Total harmonic distortion (current): Not more than 10 percent
    c. Power factor: Not less than 90 percent
    d. RF interference: Meet FCC 47 CFR Part 15/18
    e. Transient protection: IEEE C62.41 Class A.

8. All LED Assemblies shall be provided by Osram, Phillips, GE, or equal.

E. Extra Materials

1. Furnish the following extra materials matching products installed. Package with protective covering for storage and identify with labels describing contents.

    a. Five percent of quantity of LED source packages of each type, but no fewer than two of each type.
    b. One percent of quantity of louvers and lenses of each type, but not less than two of each type.
    c. Five percent of quantity of LED drivers of each type, but not less than two of each type.
    d. Ten percent of single faced exit signs, but no fewer than ten. Include 100’ of type MC cable branch circuiting and installation labor.
    e. Ten percent of double faced exit signs, but no fewer than five. Include 100’ of type MC cable branch circuiting and installation labor.

F. Interior General:

1. Furnish interior luminaries that comply with requirements specified below, indicated on the Drawings to meet conditions of installation.
2. Metal parts shall be free from burrs and sharp corners and edges.
3. Metal components shall be formed and supported to prevent sagging and warping.
4. Steel parts shall be finished with manufacturer's standard finish applied over a corrosion-resistant primer. Finish shall be free from runs, streaks, stains, holidays or defects.
5. Doors and frames shall be smooth operating and free from light leakage under operating conditions. Relamping shall be possible without the use of tools. Doors, frames, lenses and diffusers shall be designed to prevent accidental falling during relamping and when secured in the operating position.
6. Luminaires shall have minimum reflecting surface reflectance as follows unless specified otherwise on the Drawings:

    a. White Surfaces: 85 percent
    b. Specular Surfaces: 83 percent
    c. Diffusing Specular Surfaces: 75 percent

7. Lenses, diffusers, covers and globes shall be 100 percent virgin acrylic unless specified otherwise on the Drawings. Lenses shall have 0.125 inch minimum thickness. Lenses for troffers shall be injection molded.
8. Luminaires shall conform to UL 1598 - *Luminaires*. Provide product with damp location listing or wet location listing by installation location.

G. Interior Accessories

1. Provide stud supports, mounting brackets, frames, plaster rings and other accessories required for luminaire installation.
2. Furnish hangers as specified below by conditions of installation:

    a. Stem hangers shall be made of 1/2-inch steel tubing with 45 degrees swivel ball hanger fitting and ceiling canopy. Finish the same as the luminaire.
    b. Rod hangers shall be made of 1/4 inch threaded zinc-plated steel rod.

3. Use NRTL-listed T-bar safety clips for lay-in luminaires.

H. Interior Installation

1. Install interior lighting system in accordance with the NEC, manufacturer's installation instructions, approved shop drawings, and NECA National Electrical Installation Standards.
2. Have the manufacturer’s installation instructions available at the Project site.
3. Mounting heights specified or indicated on the Drawings are to the bottom of the luminaire for ceiling-mounted fixtures and to the center of the luminaire for wall-mounted fixtures.
4. Where the ceiling forms the protective membrane of a fire resistive assembly, install protective coverings over luminaires in accordance with NRTL requirements.
5. Install slack safety wires as described below for luminaires in or on suspended ceilings.

    a. Wire shall be minimum 12 gage galvanized soft annealed steel wire conforming to ASTM A641.
    b. Attach wire to the building structure directly above the attachment point on the box or luminaire; make trapezes of framing channel material to span obstacles
    c. Secure wire(s) at each end with not less than three tight turns in 1-1/2 inch.

6. Support pendant-mounted or cable-supported luminaires directly from the structure above using a 9 gage wire or an approved alternate support without using the ceiling suspension system for direct support.

    a. Install seismic restraints for pendant-mounted and cable-supported luminaires.
    b. Pendants, rods, cables, or chains 4 ft or longer shall be braced to prevent swaying using three cables at 120 degrees separation.

7. Connect luminaires in suspended ceilings using 6 ft. lengths of flexible wiring method arranged accommodate not lea than 4 inch of differential seismic movement in any direction.

I. Interior Quality Control

1. Make electrical connections, clean interiors and exteriors of luminaires, install lamps, energize and test luminaires, inspect interior lighting system, and deliver spare parts in accordance with manufacturer's instructions and NECA National Electrical Installation Standards:
2. Test electronic dimming ballasts for full range dimming capability.

    a. Check for visually detectable flicker over the full dimming range.

3. Prior to turnover to Owner, replace lamps that were installed and used during construction if more than 15 percent of their rated lamp life has been used.

J. Exterior - General

1. Furnish exterior luminaires that comply with requirements specified in this Section and in the luminaire schedule on the Drawings.
2. Luminaire photometric characteristics shall be based on IESNA approved methods for photometric measurements performed by a recognized photometric laboratory.
3. Luminaire housing shall be primarily metal.

    a. Metal parts shall be free from burrs and sharp corners and edges.
    b. Sheet metal components shall be fabricated from corrosion-resistant aluminum, formed and supported to prevent sagging and warping.
    c. Exposed fasteners shall be stainless steel.

4. Doors and frames shall be smooth operating and free from light leakage under operating conditions.

    a. Relamping shall be possible without the use of special tools.
    b. Doors, frames, lenses and diffusers shall be designed to prevent accidental falling during relamping and when secured in the operating position.
    c. Door shall be removable for cleaning or replacing lens.

5. Luminaires shall have minimum reflecting surface reflectance as follows unless scheduled otherwise:

    a. White surfaces: 85 percent
    b. Specular surfaces: 83 percent
    c. Diffusing specular surfaces: 75 percent

6. Provide lenses, diffusers, covers and globes as scheduled on the Drawings fabricated from materials that are UV stabilized to be resistant to yellowing and other changes due to aging or exposure to heat and ultraviolet radiation.
7. Doors shall have resilient gaskets that are heat-resistant and aging-resistant to seal and cushion lens and refractor.

K. Exterior Poles and Accessories

1. Furnish poles and accessories that comply with requirements specified in this Section and the luminaire schedule on the Drawings.
2. Pole, base, and anchorage shall carry the luminaires, supports, and appurtenances at the indicated height above grade without deflection or whipping.
3. Mountings, fastenings and other appurtenances shall be fabricated from corrosion-resistant materials that are compatible with poles and luminaires and will not cause galvanic action at contact points. Mountings shall correctly position luminaires to provide scheduled light distribution.
4. A reinforced access handhole shall be located in the wall of each metal pole.
5. A welded 1/2 inch grounding lug shall be accessible through the handhole of each metal pole. Grounding connection shall be designed to prevent electrolysis when used with copper ground wire.
6. Metal poles shall have anchor type bases and galvanized steel anchor bolts and leveling nuts.
7. Metal poles shall have a metal base cover that covers the entire base plate and anchorage.
8. Protect painted, anodized, or brushed pole finishes during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

9. Aluminum poles shall be fabricated from corrosion resistant aluminum Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys or Alloy 356-T4 for cast alloys.

    a. Poles shall be square or round, tapered or straight as indicated on the Drawings.
    b. Aluminum poles over 30 feet tall shall include factory-installed vibration dampers.
    c. Poles shall be seamless extruded or spun seamless type with minimum 0.188 inch wall thickness.
    d. Tops of shafts shall be fitted with a round or tapered cover.
    e. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M, Standard Specification for Aluminum-Alloy Permanent Mold Castings and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded.
    f. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

10. The poles EPA capacity shall meet the wind rating in the geographical area in which its installed. Refer to AASHTO wind map and provide appropriate wind rating with the paired light fixture. Wind rating shall be a minimum of 100MPH with 130MPH gust rating.
11. Anchor bolts shall be steel rod having minimum yield strength of 50,000 psi. The top 12 inch of the anchor bolt shall be galvanized in accordance with ASTM A153/A153M.
12. Manufacturers: Subject to compliance with requirements, provide products as scheduled or specified on the Drawings.
13. Fuses and Fuse holders

    a. Furnish fuse overcurrent protection for each pole-mounted luminaire to isolate faulted ballasts from the lighting circuit.
    b. Use 600 volt, Class CC, time-delay, current-limiting fuses.
    c. Select fuses rated between 200 percent and 300 percent of the luminaire ballast or driver maximum current.
    d. Manufacturer: Bussman “LP-CC” or approved equal.

14. Furnish in-line fuse holders for installation in pole hand hole or transformer base.

    a. Use non-breakaway type fuse holders unless breakaway poles are indicated on the Drawings.
    b. Use breakaway type fuse holders where breakaway poles are indicated on the Drawings.
    c. Load and line terminal sizes and types shall correspond to line and load conductor sizes and quantities.
    d. Both breakaway and non-breakaway fuse holders shall have insulating boots.
    e. Manufacturers: Ferraz Shawmut “FEC” for phase conductor(s), “FEBN” for neutral conductor, or approved equal.

L. Exterior Installation

1. Install products in accordance with manufacturer's instructions, NECA/IESNA 501, and approved shop drawings.

2. Locations of luminaires and poles shown on the Drawings are diagrammatic. Coordinate luminaire locations with building finishes, building structure, paving and striping, utility piping, security fences, and existing trees. Obtain approval for location changes through LANL Subcontract Technical Representative (STR).
3. Set poles and luminaires plumb, square, level and secure.
4. Install surface mounted luminaires directly to an outlet box which is supported from structure.
5. Install in-grade luminaires flush with surrounding surface. Coordinate pitch or grading of surface with Construction Manager to allow drainage away from fixture.
6. Install lamps in luminaires in accordance with manufacturer's instructions.
7. Pre-cast Concrete Foundations:

    a. Concrete shall be a minimum of 5,000 psi after 28 days.
    b. Electrical SubContractor shall coordinate conduit requirements, anchor bolt pattern, bolt projection, and approved light pole base including bolt covers with approved light pole prior to release of pre-cast base.
    c. Base shape shall match pole shape and shall be a minimum of 18 in. or 2 in. larger than pole base bolt covers.
    d. Comply with details on electrical drawings for dimensions, reveal above grade, and reinforcing.
    e. Provide Shea concrete products or equal.

8. Pole Erection

    a. Do not install poles without luminaires.
    b. Use fabric web slings to raise and set poles.
    c. Use leveling nuts or shims to make poles plumb. When leveling nuts are used, set the lower nuts not more than 1 inch from the concrete foundation.
    d. Tighten anchor bolt nuts and other pole hardware to torque recommended by manufacturer.
    e. After pole is leveled, pack non-shrink grout between anchor base and concrete foundation to provide a full bearing surface. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout; arrange to drain condensation from interior of pole.
    f. Set embedded poles to depth indicated on the Drawings, but not less than 1/6 of pole length below finish grade.
    g. Auger holes large enough to permit the use of tampers the full depth of the hole.
    h. Backfill in 6 inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of the undisturbed earth.

2.9 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. Motor Starters shall be furnished by Electrical Sub-Contractor unless part of package mechanical equipment such as rooftop units.
3. 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. Manufacturers:

1) Westinghouse
2) Square D/Groupe Schneider
3) Siemens
4) Allen Bradley
5) General Electric
6) Or equal

4. 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.

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. Manufacturers:

a. Westinghouse
b. Square D/Groupe Schneider
c. Siemens
d. Allen Bradley
e. Or equal

D. Fuses:

1. Provide a complete set of fuses for each item of fusible type equipment.
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. Manufacturers:

    a. Bussmann, Division of McGraw
    b. Gould/Shawmut
    c. GEC-ALSTHOM
    d. Or equal

2.10 ELECTRICAL SYSTEM CONTROLS AND INSTRUMENTS

A. Provide a complete power system consisting of branch circuits, motor disconnect switches, pushbutton stations, motor starters, and other devices to connect up and leave in operating condition each piece of electrically operated equipment provided either under this section or other Divisions.

B. All control wiring, not indicated in the electrical specifications or not shown on electrical drawings, will be provided by Temperature Control Subcontractor.

2.11 GROUNDING SYSTEM

A. All equipment and systems shall be grounded. Refer especially to NEC Section 250 Requiring Connections to Building Steel, Foundation, Water Service, and Interior Piping. Provide transformer pad grounding 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 5.0 ohms shall not be exceeded. 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. All receptacle circuits shall have dedicated neutrals. 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 nonmetallic 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.

L. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

M. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

N. Ground Rods: Drive rods until tops at least 6 inches below finished floor or final grade, unless otherwise indicated. Interconnect ground rods with grounding electrode conductor below grade.

O. Dry type transformer: Install an insulated grounding conductor from a transformer neutral to the building steel by means of copper wire, as scheduled on the drawings.

P. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors in conduit, from a grounding bus of the building's main service equipment to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

Q. Refer to Technology Specifications for additional grounding requirements.

R. Refer to Motorola R56 for communications systems grounding requirements.

2.12 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 shall be copper. 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. Provide 200% neutral buses on all 120/208 volt panelboards.

C. Cabinets shall be minimum of 20 inch 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. Square D is the Basis of Design.

1. 120/208 volt, three phase, four wire. Symmetrical interrupting capacity 10,000 AIC.

Style	
Westinghouse type PRL-1	BAB Breakers (bolt-on)
Square D type NQOD	QOB Breakers (bolt-on)
Siemens type CDP-7	BQ Breakers (bolt-on)

Or equal

2. Distribution Panels:

a. Where scheduled as circuit breaker type, symmetrical interrupting capacity 65,000 AIC (series rated).

b.	Westinghouse type PRL-3	FD Breakers
c.	Square D I-Line type	FA Breakers
d.	Siemens SPP	FXD6 Breakers
e.	Or equal	

F. Panelboards and distribution panels shall be of same manufacturer as switchboard. Refer to drawings where higher interrupting are required.

G. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 150 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
4. Instantaneous trip.
5. Long- and short-time pickup levels.
6. Long- and short-time time adjustments.
7. Ground-fault pickup level, time delay, and I2t response.
8. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).
9. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
10. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

H. All power panels fed from K-13 transformers shall have surge protection. Coordination and Arc flash study shall be submitted with shop drawing submittal. All circuit breaker selection shall meet study recommendations and shall be provided as recommended by study.

I. Electrical Sub-contractor shall provide infrared scanning of all panelboards after three months past substantial completion. Provide report indicating status of all terminations at respective panelboards per phase.

2.13 ELECTRIC SERVICE

A. Coordinate and cooperate with Reading Municipal Light Department, hereinafter called utility company, with respect to providing service and metering.

B. Provide all primary system raceways, elbows, pull wires and all pad grounding. Utility company will provide pad mounted transformer 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 the electrical contractor.

D. General Trades Contractor will do all excavation and back filling in accordance with utility company standards and will install the pre-cast transformer pad furnished by the E.C.

E. All work to be done in accordance with utility company standards.

F. Metering: All usage will be on one secondary meter. Electrical Contractor will furnish current transformers and potential transformers to be installed in switchboard C.T. cabinet. Provide meter socket per utility company standards. Meter will be by the Utility Co. Metering will be cold Sequence per utilitiy co. E.C. shall provide Main breaker ahead of C.T. cabinet.

2.14 STANDBY ELECTRICAL SYSTEM

A. Provide one 600KW, 750 kVA, 120/208 Volt, 3 Phase, 4 Wire at .8 PF standby power rated diesel-fueled generator set, mounted in perfect alignment on an all welded, fabricated steel sub-base which shall allow for attachment of all necessary engine and generator accessories.

B. Summary

1. Work Included: Packaged diesel engine driven electric plant including engine generator set, cooling system, fuel system, combustion air intake and engine exhaust systems, starting system, and the following additional features:

   a. Weatherproof and soundproof housing.
   b. Automatic load transfer control to provide automatic starting and stopping of the plant and switching of the load within 10 seconds.
   c. Automatic transfer switches
   d. Remote annunciator panel.
   e. State code Fuel storage tank with interstitial space monitoring.
   f. Integral Load bank
   g. 10 ft. exhaust stack for generators rated 300KW and above.

2. Provide control and alarm circuits wiring as shown on the manufacturer's diagrams and required for a complete installation.
3. Provide labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items which are usually provided with this equipment, or which are essential for proper installation and operation, even though not these may not be specifically mentioned or indicated on the drawings.

C. Manufacturers:

1. Kohler
2. Caterpillar
3. Onan/Cummings
4. Or equal

D. Engine

1. Water cooled with unit-mounted radiator. Provide starter and all field wiring required by manufacturer
2. Dry-type replaceable element air cleaners.
3. Full flow lube oil filters and bypass oil filter.
4. Twelve (12) volt starting motor, 12 volt, 3 ampere battery charging alternator.
5. Engine instrument panel to include ammeter, lube oil pressure gauge, lube oil temperature gauge, water temperature gauge, and hour meter.
6. Engine-mounted safety control to provide alarm signals for engine shutdown in event of low oil pressure, high coolant temperature, overspeed, over crank, and pre-alarms for high water temperature and low oil pressure.
7. Jacket water heater, 2000 watt, 120 or 208 volt, single phase or as recommended by generator manufacturer.

E. Generator: 600KW, 750 kVA @ .8PF,120/208 volt, 3 phase, 4 wire, 60 Hz, diesel fired 1800 RPM revolving field type main generator with brushless exciter and permanent magnet.

1. Voltage regulation + 1 percent from no load to full load.

F. Cooling System: Unit mounted radiator with flange attached.

G. Starting System: 12 volt heavy duty lead acid storage battery, connected for 12 volt DC output.

1. Battery rack, cables, and connectors shall be provided.

2. Provide 10 amp battery charger fed from a 120 volt, single phase, 60 Hz service. Battery charger to include high and low battery voltage alarm relays for derangement panel. Battery charger shall meet NFPA 110 Standards.
3. Exhaust System: Furnish one Maxim M-51 3 in. critical silencer, 3 in. side inlet, and one 3 in. end outlet complete with two (2) 3 in. companion flanges. Furnish one 3 in. x 18 in. flexible stainless steel exhaust connector, flanged on one end, threaded nipple on opposite end. Generator shall meet all applicable emissions regulations.

H. Vibration Isolators: Set of four (4) Korfund rubber type vibration isolators for installation between steel base and concrete foundation.

I. Exhaust System: Furnish one Maxim M-51 3" critical silencer, 3" side inlet, and one 3" end outlet complete with two (2) 3" companion flanges. Generator shall be Tier 3 compliant and meet all applicable emission standards.

Furnish one 3" x 18" flexible stainless steel exhaust connector, flanged on one end, threaded nipple on opposite end.

Furnish a stainless steel 10' stack exhaust extension supported from the generator housing with rain cap and all necessary components for a complete installation in accordance with Commonwealth of Massachusetts regulations. Stack shall be powder coated with black heat resistant paint.

J. Generator Control Panel:

1. To completely control operation of engine generator set. Panel to have automatic start control, AC volt meter, AC ammeter, pointer type frequency meter, volt meter, ammeter and selector switch. Alarm signals to indicate pre-low oil pressure, pre-high coolant temperature, and alarm signals to shut down engine in event of a low oil pressure, high coolant temperature, engine overspeed, or overcrank. Lights on face of panel to indicate failure. Provide dry contacts for remote disarrangement signal & louvers. Locate remote annunciator in administration area.
2. Terminal strip shall be included with alarms and prewarning devices prewired for remote annunciator specified herein. Provide wiring between generator and remote annunciator panel. Generator control switch shall be mounted on control panel face. A flashing light for selector switch "OFF" shall be included.
3. Provide molded case line circuit breakers mounted on generator in oversized terminal box. Provide oversized frame and LSIA type breaker in Life Safety branch, to ensure full selectivity coordination on the life safety system.
4. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:

    a. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
    b. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.
    c. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.

d. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
e. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.

K. Load Bank

1. Automatically controlled multiple stage resistor load bank in NEMA I enclosure intended for outdoor mounting adjacent to the generator in series with the engine radiator.
2. Characteristics: Unit shall be made up of (4) continuously rated 25% Steps, 3 phase resistance stages with voltage rating to match generator output, designed and connected so as to provide a load of up to 50% of generator rating.
3. Construction: The load bank shall be completely self-contained, incorporating all of the following, integrally mounted in a single enclosure, except as otherwise noted:

a. Four (4) independent resistance stages made up of chromium alloy wire, each so
b. connected as to provide a 50 % at rated voltage. Resistors shall operate at a temperature not to exceed 1,100 deg F (600 deg C).
c. A 3-pole magnetic contactor and 3 current limiting fuses for each stage.
d. Fused control transformer with 120 volt output.
e. Integral manual override control to permit staged manual on-off control as desired.
f. Load bank shall be located in-line with, and downstream of the generator radiator.
g. Complete set of factory installed power and control wiring. Power wiring shall be rated for 150 deg C operation.
h. Pre-wired controls shall monitor normal power and disconnect the load bank upon power outage during load bank test.

4. Construction: The load bank shall be completely self-contained, incorporating all of the following, integrally mounted in a single enclosure except as otherwise noted:

a. Load steps: Not less than four (4) independent resistance stages, made up of
b. chrome alloy wire, connected so as to provide load steps up to the total rating of the load bank. No stage shall exceed 50 KW.
c. Each resistance stage shall be independently protected by means of factory installed current limiting fuses and shall be provided with a magnetic contactor. Fuses and magnetic contactor shall be factory wired so as to provide a self-protected, individually controllable unit for each stage.
d. Main terminals arranged to accommodate a single power connection, sized for the full load rating of the load bank, complete with power circuit extensions to the protective devices for each branch circuit (i.e., stage).
e. Automatic protection against regenerative power from elevators. Include reverse
f. Both control panels include step-by-step manual control as well as status lights.

5. Malfunction detection system shall incorporate sensors, alarms and wiring for intake and exhaust air over temperature and loss of cooling airflow; so arranged as to shut down load bank to avoid overheating.
6. Complete set of factory installed power and control wiring. Cooling fan and control power shall be derived from a protected tap on the load side of the nearest transfer switch.

L. Automatic Transfer Switches:

1. Provide Open transition automatic transfer switches as shown on drawings for operation on 120/208 volts, 3 phase, 4 wire operation. Units to be housed in a NEMA 1 enclosure and shall be 3 pole as indicated on drawings.

2. The transfer switches shall be rated for 42,000 ARMS when rated over 400 amperes. Transfer switches shall be rated 42,000 ARMS when rated 400 amperes or less and fed from a current limiting breaker.
3. Entire switch shall be listed under UL 1008.
4. Manufacturers:

    a. Russ Electric
    b. ASCO
    c. Kohler
    d. Onan/Cummins
    e. Or equal

5. Unit shall be provided with standard accessories as follows.

    a. Voltage and Frequency Sensing:

        1) Close differential voltage sensing on all phases of normal pickup adjustable 85-100 percent. Dropout 75-98 percent
        2) Voltage sensing of emergency source. Adjustable pickup 85-100 percent.
        3) Frequency sensing of emergency source. Adjustable pickup 90-100 percent.

    b. Time Delays:

        1) Time delay to override momentary normal source outages. Adjustable 0.5 to 6 seconds.
        2) Retransfer to normal with 5 minute cooldown timer.

    c. Engine Control:

        1) Contact to close when normal source fails.
        2) Contact to open when normal source fails.
        3) Test switch to simulate normal source failure.

    d. Indicators: Pilot lights to indicate switch in normal position or emergency position.
    e. Auxiliary Contacts: Two (2) to close on normal. Two (2) to close on emergency.

6. Required Accessories:

    a. Plant exerciser.
    b. In-phase monitor for Motor Load Transfer, ATS-OS and ATS-LS
    c. Manual transfer to normal source.
    d. Elevator control transfer module in ATS-OS. A load control circuit consists of two sets of single pole, double throw contacts that operate 3 seconds before transfer in either direction. Contacts rated 3 amperes, 208 volts AC or 10 amperes, 32 VDC, for signal to elevator of generator power available. Provide four #14AWG conductors in 3/4 in. conduit, interlock wiring to each elevator controller from each switch controlling elevator power.

7. Engine Start control and Monitoring

    a. The Engine Start Control and Monitoring Modules shall be ASCO 5101 Engine Start Modules or equal. The solution must cover and provide complete compliance to the 2023 NEC 700.10 code.

b. The ATS shall provide continuous monitoring of the entire remote start circuit. Visual and audible annunciation of generator malfunction shall be initiated if the integrity of the start circuit is compromised.
c. There shall be minimum time delay (less than 5 seconds) in annunciation of any compromised condition such as an open or short circuit. A system which annunciates compromised conditions only after a generator start signal is initiated via a redundant path does not meet the intent of this specification.
d. The detection of a compromised start circuit shall initiate and latch the generator start circuit.
e. Each Generator Engine Start Module shall be din-rail mounted and accept up to (8) ATS Engine Start. Each channel must have its own dedicated tri-colored status LED.
f. Each Engine Start channel must have its own dedicated switch with ability to enable or disable monitoring function.
g. Engine-start circuit shall be a single pair of typical hardwire used in legacy applications. Additional wiring and components beyond specified herein does not meet the intent of this specification.

1) Coordinate placement of required components within the generator controls with the specified manufacturers.

M. Remote Annunciator Panel: A flush mounted panel shall include a visual signal that battery charger is functioning properly and both audible and visual signals. Annunciator shall meet NFPA 110 Standards.

1. Audible signal shall have a silencing switch. A lamp test button shall be provided.

N. Provide load bank test in the field by a factory certified representative for two hours at 25%. 50%, 75%, and 100% for 30 minutes at each stage and provide testing documentation. Also, provide a two hour building load test transferring the ATS switches to generator power. Provide an NFPA 110 test report for Engineer approval. The entire emergency system shall be field test operated for two (2) hours. Provide all fuel for testing. A normal power failure shall be simulated. The engine generator unit shall automatically start, come up to speed, and assume full emergency load. Entire building shall be in operation during test.

O. Miscellaneous: Necessary lube oil and anti-freeze.

P. Equipment Testing and Instruction Manual and Drawings:

1. Operating instructions and maintenance manuals shall contain the following information:

a. Operating Instructions
b. Replacement Parts
c. Wiring Diagram
d. Maintenance

2. Custodians of the equipment shall be present during test. At that time they shall be instructed in operation and maintenance.
3. Upon completion of tests, written reports containing results shall be submitted. Test reports shall contain readings taken at 30 minute intervals along with all other pertinent test information.

a. Ambient Temperature
b. Oil Pressure

c. Battery Charge Rate
d. AC Volts
e. AC Amperes All Phases
f. Frequency
g. Kilowatts
h. Power Factor

4. Submit all required documentation for registration of generator with the DEP.
5. Provide NFPA 110 equivalent testing and provide test report to engineer for approval.

Q. REMOTE ALARM ANNUNCIATOR PANEL

1. Provide a generator set remote alarm annunciator panel for installation at the location shown on the drawings.
2. Enclose the panel in NEMA 1 enclosure suitable for flush wall mounting and provide audible (A) and/or visual (V) signals for the following:

	Condition	Signal
1.	Generator set operating	V
2.	Failed to start	A/V
3.	Pre-low lube oil pressure	A/V
4.	Pre-high water temperature	A/V
5.	Low water temperature	A/V
6.	Engine overspeed	A/V
7.	Low battery voltage	V
8.	High battery voltage	V
9.	Low fuel supply	A/V
10.	Fuel leak detection	A/V

3. In the panel face, provide a separate lamp for each of the signals listed above, a lamp test pushbutton switch, and an audible alarm signal device with silence switch having ring back feature.
4. Provide a communication port to interface with the building management system for transmitting the generator set status and alarms data including alarm on a generator set failure to start automatic weekly exercise.

a. Supports industry-standard Modbus_RTU protocol.
b. Uses either an RS-232 or RS-485 Network port.
c. Communicates at baud rates up to 19200.
d. Allows selection of an access code for remote programming.
e. Remotely monitors system operation including run times, shutdowns, warnings, and input/output activity.
f. Allows selection of either metric (SI) or English (IP) units.
g. Provides more than 100 different Modbus_message codes for system monitoring, including System Ready and Generator Running.
h. Provides remote programming of most system parameters including time delays, trip points, voltage, frequency, and current.
i. Allows remote engine start/stop and controller reset.

R. Coordination of Trades:

1. The following equipment shall be furnished by Electrical Contractor but shall be installed under other sections.

a. Anchor bolts to be installed by General Trades Contractor based on approved shop drawings.

S. Generator Outdoor Housing

1. The engine generating set shall be factory installed in a weatherproof outdoor housing. The housing shall provide year round generating set protection against adverse weather and environmental conditions. The enclosure shall be sound attenuated and meet Federal Specifications.
2. The weatherproof shelter shall be constructed or welded and bolted of reinforced aluminum, 14 gauge walls and 14 gauge floor plate. All metal parts shall be prime coated and finished painted.
3. The shelter assembly shall have shuttered air openings on front and sides with mesh screens covering side shutters. The air shutters shall be opened by four 22 volt AC motors when the generating set operates. Motors shall be spring loaded to close shutters when set stops.
4. Hinged double doors on each side and one door in rear of the shelter shall allow easy access to engine generator and controls. All door handles shall be key lock design.
5. Vibration isolators of the open coil spring type, selected for 3 inch (76mm) static deflection, shall be furnished and installed. The number of isolators shall be as recommended by the generator set manufacturer, and complete details shall be included in the Submittals. Anchor bolts, nuts and sleeves shall be supplied with recommended Foundation Plan.
6. Provide an integral base mounted tank, double wall containment with alarms and capacity to run generator for 72 hours at 100% load. Include conduit entry provisions for tank. Tank shall be supplied in accordance with the state Fuel Storage Codes for above ground diesel fuel tanks. Provide 1,200 gallons of diesel fuel. Provide tank level gauge at annunciator.
7. The weatherproof housing shall allow installation of the silencer outside or inside the enclosure. Provide critical type silencer. Refer to riser for additional requirements regarding the 10’ stack.
8. Provide sound deadening materials, baffles, hoods, etc. to reduce noise levels to 75DBA at 7 meters in any direction.
9. Provide weatherproof EPO with cover on the exterior of the generator enclosure that shuts down the primer mover per NEC.

a. .

2.15 MANUAL TRANSFER SWITCH

A. Scope:

1. Electrical SubContractor shall furnish, deliver, install and test the manual transfer switches as specified herein and in accordance with the drawings.

B. Quality Assurance:

1. Manual transfer switch shall be UL listed and labeled under the UL 1008 standard.
2. Manual transfer switch manufacturer shall provide a complete factory assembled, wired and tested manual transfer switch.
3. Manual transfer switch shall be factory Hi-pot tested for a period of not less than 60 seconds.
4. Manual transfer switch installation shall meet all applicable NEC standards.

C. Submittals:

1. Electrical SubContractor shall submit manufacturer's drawings and data of manual transfer switches for Engineer's approval prior to start of fabrication. Drawings and data shall include, as a minimum, dimensioned general arrangement drawings and wiring diagrams, UL listing information including UL control or file number, component data, mounting provisions, conduit entry locations and installation instructions.
2. Upon installation of manual transfer switches Electrical SubContractor shall submit manufacturer's Operating & Maintenance Manual which shall include as a minimum:

    a. Certified as-built General Arrangement drawings and Wiring Diagram.
    b. Materials / Component List including part numbers.
    c. Maintenance and service requirements.
    d. Certificate of Compliance and hi-pot test data.

D. Warranty:

1. Manual transfer switches shall be covered by manufacturer's warranty for a minimum period of one year after shipment from manufacturer.

E. General:

1. All equipment shall be new.
2. Manual transfer switch manufacturer must have produced and sold manual transfer switches as a standard product for a minimum of three years.
3. Manual transfer switches shall be molded case circuit breaker type; knife switch or fused switches are not acceptable.
4. Electrical SubContractor 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. Manual transfer switches shall be StormSwitch, Model "SSDX-400A-H-400A-H-480-3-1-1-D-C" as manufactured by ESL Power Systems, Inc. or equal as approved by the Engineer.

F. Manual Transfer Switches:

1. Manual transfer switch shall consist of two mechanically-interlocked molded case circuit breakers, cam-style male connectors, power distribution block and grounding terminals, all housed within a padlockable enclosure.
2. Manual transfer switch enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated galvanneal steel. The main access shall be through an interlocked, 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 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 light gray RAL 7038.

3. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. 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. Each of the phase cam-style male connectors within the enclosure shall be factory-wired to a molded case circuit breaker. 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. The neutral cam-style male connectors, if required, shall be factory wired to a power distribution block. None of the cam-style male connectors shall be accessible unless both molded case circuit breakers are in the “OFF” position and the main access door is open.
4. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.
5. Molded case circuit breakers shall be UL Listed and the short circuit interrupt rating shall be a minimum of 35kAIC at 480VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall be fed from utility power; the other molded case circuit breaker shall be fed from the cam-style male connectors to supply power from a portable generator. Both molded case circuit breakers shall include UL Listed door-mounted operating mechanisms, preventing the opening of the main access door unless both breakers are in the “OFF” position. Both molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the “ON” position. The (2) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only one breaker can be closed at any given time.
6. Manual transfer switch shall be suitable for use as service equipment in the USA.

G. Installation:

1. Prior to installation of manual transfer switches, Electrical SubContractor shall examine the areas and conditions under which the manual transfer switch is to be installed and notify the Engineer in writing if unsatisfactory conditions exist.
2. Manual transfer switch shall be installed as shown on the drawings and per the manufacturer’s written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association’s “Standard of Installation”.
3. Conduit entry into the manual transfer switch shall be by Electrical SubContractor; Electrical SubContractor shall furnish and install listed watertight conduit hubs, as manufactured by MYERS or T&B, for each conduit entry on the manual transfer switch. The incoming hub size shall match the conduit size for feeders and ground as shown on the drawings. The outgoing hub size shall match the conduit size for loads and ground as shown on the drawings. Hubs shall be properly installed and tightened to maintain Type 3R integrity of the manual transfer switch enclosure.
4. Electrical SubContractor shall terminate feeder conductors, load conductors and ground per the manufacturer’s instructions. Use copper wire only for all conductors and grounds. All field wiring terminations shall be torqued as required per the instructions on the manual transfer switch’s power distribution block, circuit breaker & ground lug.

H. Field Testing:

1. Prior to energizing manual transfer switch, the Electrical SubContractor shall perform the following checks and tests as a minimum:

    a. Verify mounting and connections are complete and secure.
    b. Verify internal components and wiring are secure.
    c. Perform continuity check of all circuits.

d. Perform 1,000 VDC megger test on feeder, load and ground cables.
e. Verify deadfront is secure.
f. With the manual transfer switch deadfront in place and the main access door closed and properly latched, actuate both Operator Mechanisms; verify only
g. (1) breaker at a time can be turned to the “ON” position.
h. Confirm operation of the manual transfer switch ground receptacle by attaching a plug to the manual transfer switch ground receptacle and then verify that the plug is grounded to the facility ground.
i. Once utility power has been applied, confirm operation of manual transfer switch by following directions on main access door.

2.16 FIRE ALARM AND DETECTION SYSTEM

A. Description:

1. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm network equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Network Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.
2. The fire alarm system shall comply with requirements of latest NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
3. The fire alarm manufacturer shall be of the highest caliber and insist on the highest quality. The system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
4. The FACP and peripheral devices shall be manufactured 100 percent by a single U.S. manufacturer (or division thereof).
5. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the UL listing.
6. The installing company shall employ NICET (minimum Level II Fire Alarm Telecommunications) technicians on site to guide the final check-out and to ensure the systems integrity.

B. Scope:

1. A new network intelligent reporting, microprocessor controlled fire detection and alarm system shall be installed in accordance with the specifications and drawings.
2. Basic Performance:

a. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto NFPA Style 7 (Class A) Signaling Line Circuits (SLC).
b. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).
c. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z).
d. Digitized electronic signals shall employ check digits or multiple polling.
e. Power for initiating devices and notification appliances must be from the main fire alarm control panel.
f. A single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
g. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

3. Basic System Functional Operation:
4. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

    a. The FACP alarm LED on the FACP shall flash.
    b. A local piezo-electric signal in the FACP control panel shall sound.
    c. The 80-character LCD display on the local FACP node and on the intelligent network display shall indicate all information associated with the fire alarm condition, including the type of alarm point, and its location within the protected premises. This information shall also be displayed on the network reporting terminal.
    d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
    e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

5. Software Modifications:

    a. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
    b. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm network on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

6. Certifications:

    a. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer and trained on network applications. Include names and addresses in the certification.
    b. Power supplies, relays, water flow switches and all accessories of the fire alarm system.
    c. Each circuit in the fire alarm network shall be tested semiannually.
    d. Each smoke detector shall be tested in accordance with the requirements of NFPA 72, Chapter 7.

C. Applicable Publications:

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

1. National Fire Protection Association (NFPA) - USA:

    No. 72 National Fire Alarm Code
    No. 70 National Electric Code
    No. 101 Life Safety Code

2. Underwriters Laboratories Inc. (UL) - USA:

No. 50	Cabinets and Boxes
No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 228	Door Closers-Holders for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1481	Power supplies for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances

3. Local and State Building Codes.
4. All requirements of the Authority Having Jurisdiction (AHJ).

D. Approvals:

1. The system must have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories Inc.
FM	Factory Mutual
MEA	Material Equipment Acceptance (NYC)
CSFM	California State Fire Marshal

2. The fire alarm control panel shall meet the modular labeling requirements of Underwriters Laboratories, Inc. Each subassembly, including all printed circuits, shall include the appropriate UL modular label. Systems which do not include modular labels which may require return to the manufacturer for system upgrades, and are not acceptable.

E. Equipment and Material, General:

1. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
2. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.
3. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

F. Conduit and Wire:

1. Conduit:

a. Conduit shall be in accordance with the National Electrical Code (NEC), local and state requirements.
b. All wiring exposed shall be installed in conduit. All wiring exposed in finish spaces shall be in surface metal raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
c. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.
d. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
e. Conduit shall not enter any FACP, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
f. Conduit shall be 3/4 inch (19.1 mm) minimum.

2. Wire:

a. All fire alarm system wiring must be new, unless specified herein.
b. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 16 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.32 mm) for notification appliance circuits.
c. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
d. Wiring used for the SLC multiplex communication loop shall be twisted and shielded unless specifically excepted by the fire alarm equipment manufacturer.
e. All field wiring shall be completely supervised.
f. MC cable with red armor may be used where concealed and allowed by code.

3. Terminal Boxes, Junction Boxes and Cabinets:
4. All boxes and cabinets shall be UL listed for the intended purpose.
5. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
6. The FACP shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution Panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The FACP cabinet shall be grounded securely to either a cold water pipe or grounding rod. Provide lock-on device on breaker.

G. Fire Alarm Control Panel:

1. Fire alarm control panel shall be Notifier NFS3030, Edwards EST3, FCI-E3, or equal. The FACP shall contain a microprocessor based central processing unit (CPU). The FACP shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, local and remote operator terminals, annunciators, and other system controlled devices.
2. Node Capacity and General Operation:

   a. Each node shall provide, or be capable of, expansion to 198 intelligent addressable devices and 198 monitor/control modules for a total of 396 intelligent devices per system. FACP shall have 2 intelligent loops.
   b. Each FACP node shall include a full featured operator interface control and annunciation panel which shall include a backlit Liquid Crystal Display (LCD), individual, color coded system status LEDs, and an alpha-numeric keypad for field programming and control of the node.
   c. All programming or editing of the existing programming the system shall be achieved without special equipment or interrupting the alarm monitoring functions of the fire alarm control panel.
   d. Each FACP node shall provide the following features:

Block Acknowledge	Printer Interface
Control-by-Time	Non-Alarm Module Reporting
Day/Night Sensitivity	Periodic Detector Test
Device Blink Control	Remote Page
Drift Compensation	Trouble Reminder
NFPA 72, Sensitivity Test computer	Upload/Download to PC
System Status Reports	Verification Counters
Security Monitor Points	Walk Test
Alarm Verification	Maintenance Alert

3. Loop Interface Board (LIB):

   a. Loop interface boards shall be provided to monitor and control each of the Signaling Line Circuit (SLC) loops in the network node. The loop interface board shall contain its own microprocessor and shall be capable of operating in local mode in the case of a failure in the main CPU of the control panel. In local mode, the loop interface board shall detect alarms and activate output devices on its own SLC loop.

b. The LIB shall not require any jumper cuts or address switch settings to initialize SLC Loop operations.
c. The loop interface board shall provide power to, and communicate with, all of the intelligent detectors and addressable modules connected to its SLC Loop over a single pair of wires. This SLC Loop shall be capable of operation as NFPA Style 4, Style 6, or Style 7.
d. The LIB shall be able to drive two Style 4 SLC loops, each up to 10,000 feet in length, for an effective loop span of 20,000 feet.
e. The loop interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The loop interface board software shall include software to automatically adjust and compensate for dust accumulation to maintain detector performance as it is affected by environmental factors. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
f. The LIB shall communicate with each intelligent addressable detector and addressable module on its SLC loop and verify proper device function and status. Communication with up to 198 intelligent devices shall be performed every 6 seconds or less.

4. Enclosures:

a. Control panels shall be housed in UL listed cabinets suitable for surface or semi-flush mounting. Cabinets shall be corrosion protected, given a rust-resistant prime coat, and the manufacturer's standard finish.
b. The back box and door shall be constructed of .060 steel with provisions for electrical conduit connections into the sides and top.
c. The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.
d. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

5. FACP nodes shall be designed so that it permits continued local operation of remote transponders under both normal and abnormal network communication loop conditions. This shall be obtained by having transponders operate as local control panels upon loss of network communication.
6. FACP nodes shall be modular in construction to allow ease of servicing. Each CPU and transponder shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems which require use of external programmers or change of EPROM’s are not acceptable.
7. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients including RFI and EMI.
8. Each peripheral device connected to the FACP node CPU shall be continuously scanned for proper operation. Data transmissions between network nodes, FACP CPUs, transponders, and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques. Failure of any transponder or peripheral device to respond to an interrogation shall be annunciated as a trouble condition.
9. FACP Power Supplies:

a. Main power supplies shall operate on 120 VAC, 60Hz, and shall provide all necessary power for the FACP.
b. Each main supply shall provide 3.0 amps of usable notification appliance power, using a switching 24 VDC regulator.

c. The main power supply shall be expandable for additional notification appliance power in 3.0 ampere steps. Provide dedicated power supplies for signal circuit.
d. Each main power supply shall provide a battery charger for 60 hours of standby using dual-rate charging techniques for fast battery recharge. It shall charge 55 Amp hour batteries with-in a 48 hour period.
e. The supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults on sensitive addressable modules.
f. It shall provide meters to indicate battery voltage and charging current.
g. The main power supply shall be power-limited per 1995 UL864 requirements.

10. System Circuit Supervision:

a. Each FACP node shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and annunciate loss of communications with these devices. The FACP CPU shall continuously scan the above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate which device or devices are not responding and print the information on the printer.
b. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.

11. Field Wiring Terminal Blocks:

a. For ease of service, all wiring terminal blocks shall be the plug-in type and have sufficient capacity for 18 to 12 AWG wire. Fixed terminal blocks are not acceptable.

12. Field Programming:

a. The system shall be programmable, configurable and expandable in the field without the need for special tools or electronic equipment and shall not require field replacement of electronic integrated circuits.
b. All local FACP node programming shall be accomplished through the FACP keyboard.
c. All field-defined programs shall be stored in non-volatile memory.
d. The programming function shall be enabled with a password that may be defined specifically for the system when it is installed. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level is used for status level changes such as zone disable or manual on/off commands. A second (higher-level) is used for actual change of program information.

13. Specific System Operations:

a. Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent detectors in the FACP node from each system keypad or from the keyboard of the video terminal. Sensitivity range shall be within allowed UL limits.
b. Alarm Verification: Each of the intelligent addressable detectors in the system may be independently selected and enabled for alarm verification. Each FACP shall keep a count of the number of times each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
c. System Point Operations:

1) All devices in the FACP node may be enabled or disabled through the local keypad or video terminal.

2) Any FACP node output point may be turned on or off from the local system keypad or the video terminal.

d. Point Read: The FACP node shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point will be annunciated for the parameters listed:

1) Device Status
2) Device Type
3) Custom Device Label
4) Software Zone Label
5) Device Zone Assignments
6) Detector Analog Value
7) All Program Parameters

e. System Status Reports: Upon command from a password-authorized operator of the system, a status report will be generated, and printed, listing all local FACP system status.

f. System History Recording and Reporting: Each FACP node shall contain a history buffer that shall be capable of storing a minimum of 400 system events. Each local activation will be stored and time and date stamped with the actual time of the activation, 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.

g. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.

h. Automatic Detector Maintenance Alert: Each FACP node shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

i. 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, network 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. Addressable Devices – General:

1. Addressable devices shall use simple to install and maintain decade (numbered 1 to 10) type address switches.
2. Addressable devices which use a binary address setting method, such as a Dip switch, are difficult to install and subject to installation error. This type of device is not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the FACP signaling line circuit.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash 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 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.
5. Smoke detector sensitivity shall be set in the fire alarm control panel and shall be adjustable in the field through the field programming of the system. Sensitivity may be automatically adjusted by the panel on a time-of-day basis.

6. 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, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base 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 Class A applications.
8. 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 magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. 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.
11. A magnetic test switch shall be provided to test each detector for 100 percent obscuration, reported to the FACP.
12. Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100 percent of the alarm threshold.

I. Addressable Pull Box (manual station):

1. Addressable pull 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. 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.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual stations 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 or larger.
4. Stations shall be suitable for surface mounting or semiflush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.
5. Manual pull stations shall be of the double action type.

J. Intelligent Photoelectric Smoke Detector:

1. The detectors 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.

K. Intelligent Thermal Detectors:

1. Thermal detectors shall be intelligent 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. It shall connect via two wires to the fire alarm control panel signaling line circuit. Up to 99 intelligent heat detectors may connect to one SLC loop.

L. Intelligent Duct Smoke Detector:

1. The in-duct smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. 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.

M. Duct mounted carbon monoxide detector:

1. Manufactured by Air Products and Controls Model SL-701 or Equal
2. Product Specifications:

Voltages available:	230VAC, 115VAC, 24VAC, 24VDC
APPROVALS	Electrochemical Carbon Monoxide Sensor is a UL Recognized component in accordance with the requirements of UL2034. Also meets EN50291 requirements. SL-2000 Series Duct Smoke Detector Fire Alarm Certifications referenced side one: UL & CUL Listed (UL268A, UROX, UROX7) File # S2829 CSFM Listed (3240-1004:105); MEA Accepted (73-92-E, VOL. 27)
SAMPLING TUBES Provide required length for duct coordinate with HVAC drawings	Sectional sampling tube Metal sampling tube for 6” to 2.5’ duct width Metal sampling tube for 2.5’ to 5.0’ duct width Metal sampling tube for 5.0’ to 10.0’ duct width
ACCESSORIES	MSR-50/CO remote accessory TG-701 aerosol test gas T-PB power supplies WP-2000 weatherproof enclosure (All available from Air Products and Controls Inc.)

POWER REQUIREMENTS

Input Power	Standby Current	Alarm Current
24VAC	55mA	190mA
24VDC	14mA	68mA
115VAC	22mA	32mA
230VAC	12mA	18mA

RELAY CONTACT RATING:

Alarm Contacts	Resistive load: 2 sets form “C” rated at 10 Amps @ 115VAC Resistive load: 1 set form “A” rated at 2 Amps
Trouble Contacts	Resistive load: 1 set form “C” rated at 10 Amps @ 115VAC

AIR VELOCITY	100 to 4,000 ft. /min.

AMBIENT TEMPERATURE	32ºF to 158ºF (0ºC to 70ºC)
HUMIDITY	10% to 85% RH Non-Condensing / Non-Freezing
WIRING	Solid or stranded: #12 to #22 AWG terminals
MATERIAL	Grey plastic back box, clear plastic cover (Makrolon 94V-0) Do not expose to corrosive atmospheres.
DIMENSIONS	13 ½" L x 4 ½" W x 2 ¼" D
MAX. NET WT.:	2 ½ lbs.
HARDWARE	7" exhaust tube, FAST Tube starter sampling tube, sampling tube end cap, mounting template, and mounting hardware included.

N. Addressable Dry Contact Monitor Module:

1. 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 SLC loops.
2. The monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box.
3. The IDC zone may be wired for Style D or Style 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.
4. 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 x 1-1/4 inch x 1/2 inch. This version need not include Style D or an LED.

O. Two-Wire Detector Monitor Module:

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The two-wire monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box or with an optional surface backbox.
3. The IDC zone may be wired for Class A or B (Style D or Style 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.

P. Addressable Control Module:

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.
2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.
3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100 percent of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
4. Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply.
5. The control module shall be suitable for pilot duty applications and rated for a minimum of .6 amps at 30 VDC.

Q. Isolator Module:

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. 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. At least one isolator module shall be provided for each floor or protected zone of the building.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require any 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.
4. The isolator module shall mount in a standard 4-inch deep electrical box or in a surface mounted backbox. It 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.

R. LCD Alphanumeric Display Annunciator:

1. The alphanumeric display annunciator shall be a supervised, backlit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions from either the network node or complete network, via the INA.
3. Up to 32 LCD annunciators may be connected to a specific (terminal mode) EIA 485 interface. LCD annunciators shall not reduce the annunciation capacity of the system. Each LCD annunciator shall include vital system wide functions such as, system acknowledge, silence and reset.
4. LCD display annunciators shall mimic the local control panel 80 character display or network annunciator and shall not require special programming.
5. The LCD annunciator shall have the same vital functions as the fire alarm control panel.

S. Batteries and External Charger:

1. Battery:

   a. Batteries shall be 12 volt, Gell-Cell type.
   b. The battery shall have sufficient capacity to power the fire alarm system for not less than 60 hours plus 15 minutes of alarm upon a normal AC power failure.
   c. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills and leakage shall not be required.

T. Audio/Visual Unit (Xenon Strobe):

1. Combination horn strobe units - Provide Truealert Non-Addressable 75 Cd, Red Sync. Two Wire. Comprised of a 24 VDC Xenon Flash Tube entirely solid state. The unit shall require a sync. Control module. Provide True 75 Cd from all axis.
2. Combination horn strobe units - Provide Truealert Non-Addressable 110 Cd, Red Sync. Two-Wire. Comprised of a 24 VDC Xenon Flash Tube entirely solid state. The unit shall require a sync. Control module. Provide True 110 Cd from all axis.
3. Visual only – Provide Truealert Non-Addressable 15 Cd, Red Sync. Two-Wire comprised of a 24 VDC Xenon flash tube entirely solid state.

U. Magnetic Door Holders:

1. Provide Semi-Flush or Flush Wall Mounted, 24 V.D.C. with catch plate.

V. Provide clear plastic covers with local audible alarm for pull stations in cell block area, where indicated on drawings, and required by fire department.

W. Alarm Transmission:

1. FACP to include “UDACT” communicator with Contract ID to report by device.

X. Testing:

1. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
2. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

    a. Factory trained and certified.
    b. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
    c. International Municipal Signal Association (IMSA) fire alarm certified.
    d. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

3. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
4. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
5. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.
6. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
7. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.
8. Final Test, Certificate of Completion, and Certificate of Occupancy:

    a. Test the entire system new 100 percent devices as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.

9. Fire Alarm Testing and Maintenance Agreement

    a. Provide a one-year inspection and testing agreement in accordance with local Fire Department requirements and NFPA 72 recommendations. The holder of the testing and maintenance contract shall be a properly licensed and NRTL certified provider of Fire Alarm services and acceptable to the Fire Department.
    b. Fire alarm testing agreement shall provide for a minimum of four inspections per year. Upon completion of each test, list actual devices checked. Provide a report to the Owner.

Y. Training:

1. Provide two (2) 4-hour sessions of Owner training with Owner's Representative.

2.17 SURGE PROTECTION DEVICES

A. SCOPE

1. This section describes the materials and installation requirements for surge protective devices (SPD) for the protection of all main service and panelboards.

B. SUBMITTALS

1. Submit shop drawings and product information for approval and final documentation in the quantities listed according to the Conditions of the Contract. All transmittals shall be identified by customer name, customer location, and customer order number.
2. Submittals shall include UL 1449 3rd Edition Listing documentation verifiable by visiting www.UL.com, clicking "Certifications" link, searching using UL Category Code: VZCA and VZCA2:

    a. Short Circuit Current Rating (SCCR)
    b. Voltage Protection Ratings (VPRs) for all modes
    c. Maximum Continuous Operating Voltage rating (MCOV)
    d. I-nominal rating (I-n)
    e. SPD shall be UL listed and labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications

3. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.
4. Minimum of ten (10) year warranty

C. RELATED STANDARDS

1. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,
2. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,
3. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
4. National Electrical Code: Article 285
5. UL 1283 - Electromagnetic Interference Filters
6. UL 1449, Third Edition, effective September 29, 2009 – Surge Protective Devices

D. QUALITY ASSURANCE

1. Manufacturer Qualifications: Engage a firm with at least 5 years' experience in manufacturing transient voltage surge suppressors.
2. Manufacturer shall be ISO 9001 or 9002 certified.

3. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
4. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

E. DELIVERY, STORAGE AND HANDLING

1. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

F. MANUFACTURERS

1. Provide an internally mounted Surge Protective Devices (SPD) formerly called Transient Voltage Suppressor (TVSS) by:

   a. Siemens Industry.
   b. Current Technology
   c. LEA
   d. Liebert
   e. APT
   f. Or equal

G. ELECTRICAL DISTRIBUTION EQUIPMENT

1. Service Entrance

   a. SPD shall be UL 1449 labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications, verifiable at UL.com, without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
   b. SPD shall be factory installed integral to electrical distribution equipment.
   c. SPD shall be UL labeled with 20kA I-nominal (I-n)
   d. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR).
   e. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
   f. True 10 Mode Protection paths: SPD shall provide "directly connected protection elements" between all possible modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
   g. SPD shall be connected external of the distribution equipment with an appropriately sized 200kA SCCR rated disconnect.
   h. SPD shall meet or exceed the following criteria:

      1) Maximum 7-Mode surge current capability shall be 300kA per phase.
      2) Maximum 10-Mode surge current capability shall be 300kA per phase.
      3) UL 1449 - Third Edition Revision; effective September 29, 2009 Voltage Protection Ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L	MCOV
208Y/120	800V	800V	800V	1200V	150V

i. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (percent)	MCOV
208Y/120	25 percent	150V

j. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.
k. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
l. SPD shall include a serviceable, replaceable module.
m. SPD shall be equipped with the following diagnostics:

1) Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
2) Audible alarm with on/off silence function and diagnostic test function (excluding branch).
3) Form C dry contacts
4) Optional – Surge Counter
5) No other test equipment shall be required for SPD monitoring or testing before or after installation.

n. SPD shall have a response time no greater than 1/2 nanosecond.
o. SPD shall have a 10 year warranty.

2. Distribution Panel

a. SPD shall be UL 1449 labeled as Type 4 intended for Type 1 or Type 2 applications, verifiable at UL.com, without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
b. SPD shall be factory installed integral to electrical distribution equipment.
c. SPD shall be UL labeled with 20kA I-nominal (I-n)
d. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR).
e. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
f. SPD shall be connected to the buss of the distribution equipment with an appropriately sized 200kA SCCR rated disconnect.
g. SPD shall meet or exceed the following criteria:

1) Maximum 7-Mode surge current capability shall be 100kA per phase.
2) Maximum 10-Mode surge current capability shall be 150kA per phase.
3) UL 1449 - Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L	MCOV
208Y/120	800V	800V	800V	1200V	150V

a) UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (percent)	MCOV
208Y/120	25 percent	150V

h. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.
i. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
j. SPD shall include a serviceable, replaceable module.
k. SPD shall be equipped with the following diagnostics:

1) Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
2) Audible alarm with on/off silence function and diagnostic test function (excluding branch).
3) Form C dry contacts
4) Optional – Surge Counter
5) No other test equipment shall be required for SPD monitoring or testing before or after installation.

l. SPD shall have a response time no greater than 1/2 nanosecond.
m. SPD shall have a 10 year warranty.]

3. Branch Panels

a. The panelboard shall be UL 67 Listed and the SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.
b. The unit shall be top or bottom feed according to requirements. A circuit directory shall be located inside the door.
c. SPD shall meet or exceed the following criteria:

1) Maximum 7-Mode surge current capability shall be 100kA per phase.
2) Maximum 10-Mode surge current capability shall be 150kA per phase.
3) UL 1449 - Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L	MCOV
208Y/120	800V	800V	800V	1200V	150V

d. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (percent)	MCOV
208Y/120	25 percent	150V

e. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.
f. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
g. SPD shall include a serviceable, replaceable module.
h. SPD shall be equipped with the following diagnostics:

1) Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
2) Audible alarm with on/off silence function and diagnostic test function (excluding branch).
3) Form C dry contacts
4) Optional – Surge Counter
5) No other test equipment shall be required for SPD monitoring or testing before or after installation.

i. SPD shall have a response time no greater than 1/2 nanosecond.
j. SPD shall have a 10 year warranty.
k. The unit shall have removable interior.
l. The main bus shall be [copper] [aluminum] and rated for the load current required.
m. The unit shall include a 200 percent rated neutral assembly with copper neutral bus.
n. The unit shall be provided with a safety ground bus.
o. The field connections to the panelboard shall be main lug or main breaker.
p. The unit shall be constructed with flush or surface mounted trim and shall be in a NEMA Type 1 enclosure.

H. INSTALLATION

1. Install per manufacturer's recommendations and contract documents.

I. ADJUSTMENTS AND CLEANING

1. Remove debris from installation site and wipe dust and dirt from all components.
2. Repaint marred and scratched surfaces with touch up paint to match original finish.

J. TESTING

1. Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacture's recommendations.
2. Check all installed panels for proper grounding, fastening and alignment.

K. WARRANTY

1. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

2.18 AUTOMATED LIGHTING CONTROL SYSTEM

A. General: Summary

1. Section Includes:

a. Addressable Networked Light Management System.

B. References

1. National Fire Protection Association (NFPA)
2. cULus Listing/Certification

a. Certified as Energy Management Equipment (UL 916)

b. Certified as Emergency Lighting Equipment (UL 924)
c. Meet Heat and Smoke Release for Air-Handling Spaces (UL 2043)

3. Federal Communications Commission (FCC) / Industry Canada (IC)
4. California Energy Commission (CEC)
5. Local Building Codes

C. System Description

1. Lighting Control System includes computer-based software that provides control, configuration, monitoring and reports. System including but not limited to the following components:

a. Central Control Unit
b. System Server
c. 0-10V Dimming, Fixed Output Ballasts or 0-10V LED Drivers
d. System Field Devices (Input and Output Modules)
e. Lighting Control System Software
f. Lighting Controllers
g. Communication Wire
h. Occupancy sensors
i. Photo sensors
j. Wireless site lighting control modules (#WSLC), one per pole mounted fixture
k. Wireless Manager for site lighting
l. Wireless Control modules #WCM
m. Lighting control panels
n. Interface to audio visual equipment
o. Interface to BACnet
p. Interface to Tridium Niagara
q. Incandescent low-voltage dimming modules
r. Tunable white light programming
s. Coordination of final lighting programming
t. Owner training

D. Submittals

1. Bill of Materials: Complete list of all parts needed to fully install selected system components.
2. Product Data: For each type of product indicated.
3. Shop and Wiring Drawings: Submit shop drawings detailing control system, as supplied, including one-line diagrams, wire counts, coverage patterns, interconnection diagrams showing field-installed wiring and physical dimensions of each item.
4. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

a. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
b. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

5. Software Operational Documentation:

a. Software operating and upgrade manuals.

b. Program Software Backup: On compact disc or DVD, complete with data files.
c. Print out of software application and graphic screens, or upon request, a live demonstration of Control, Configure and Analyze functionality or a video demonstrating above stated system capabilities.

6. Installation Instructions: Manufacturer's installation instructions.
7. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
8. Warranty: Copy of applicable warranty.

E. Quality Assurance

1. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.
2. Manufacturer Requirements: The manufacturer shall have a minimum of 10 years experience manufacturing networked lighting control systems and shall provide 24/7 telephone support by qualified technicians.
3. Contractor shall ensure that lighting system control devices and assemblies are fully compatible and can be integrated into a system that operates as described in the lighting control notes on drawings and as described within this specification. Any incompatibilities between devices, assemblies, and system controllers shall be resolved between the contractor and the system provider to ensure proper system operation and maintainability.
4. Performance Requirements: provide all system components that have been manufactured, assembled, and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.
5. Performance Testing Requirements

a. Manufacturer shall 100 percent test all equipment prior to shipment. Sample testing is not acceptable.

6. Code Requirements

a. System Control Unit and System Field Devices shall be cULus listed and certified.
b. All system components shall be FCC /IC compliant.
c. All system components shall be installed in compliance with National Electrical Codes and Canadian Electrical Code.
d. Building Codes: All units shall be installed in compliance with applicable, local building codes.

7. ISO Certification: System components shall be manufactured at ISO-9000 certified plants.

F. COORDINATION

1. Coordinate lighting control components to form an integrated interconnection of compatible components.

a. Match components and interconnections for optimum performance of lighting control functions.
b. Display graphics showing building areas controlled; include the status of lighting controls in each area.

G. Delivery, Storage & Handling

1. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
2. Delivery: Deliver materials in manufacturer's original, unopened, undamaged packaging with intact identification labels.
3. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

H. Warranty

1. On-going system expansion, service and support shall be available from multiple factory certified vendors. Recommended service agreements shall be submitted at the time of bid complete with manufacturers suggested inventory and pricing for system parts and technical support labor.
2. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
3. Manufacturer's Warranty: All equipment shall be warranted free of defects in materials and workmanship.

    a. Warranty Period: All system hardware components shall have full warranty (non-prorated) for at least four years and all software components shall carry a warranty of 90 days from date of installation.
    b. Owner Rights: Manufacturer's warranty is in addition to, not a limitation of, other rights the Owner may have under contract documents, or warranties of third party component manufacturers.

I. Basis of Design Products

1. Controls: ENCELIUM Energy Management System by OSRAM SYLVANIA
2. Sensors: ENCELIUM Sensors by OSRAM SYLVANIA & Hubbell Building Automation, Inc.

J. Acceptable Alternate Manufacturers

1. Controls: Lutron, N-light, Philips, or equal.
2. Sensors: Lutron, Sensor Switch, Watt Stopper, Leviton, Cooper or equal.

K. System Performance Requirements

1. This specification is intended to fully describe all of the design, engineering, programming, hardware, software, ancillary devices and associated technical services required to provide a building-wide networked lighting control system. This system is specified to perform scheduled and automated lighting control sequences.
2. The lighting control "system" shall include a fully distributed WAN/LAN network of global controller/routers, individually addressable System Field Devices, sensors, switches, relays and other ancillary devices required for a complete and operable system. The system WAN/LAN shall be commissioned by ENCELIUM personnel or other ENCELIUM certified commissioning contractors.
3. The basis of system design shall utilize non-propriety industry standard 0-10V dimming or fixed output ballasts and/or 0-10V LED drivers, occupancy sensors, and daylight sensors.
4. On-going system expansion, service and support shall be available from multiple factory certified vendors. Recommended service agreements may be submitted at the time of bid

complete with manufacturers suggested inventory and pricing for system parts and technical support labor.

5. Lighting Control Software: The system shall offer two separate levels of lighting control: one personal lighting control for the average building occupant to control and adjust basic lighting functions in their workspace, and two central lighting control for the facility lighting administrator to perform energy management, configuration maintenance, monitoring operations, and providing support to building occupants.

    a. Native central control software shall be utilized for energy reporting status and complete programming without the need for any third party hardware or software. Systems that require any third party linked software or graphics shall be unacceptable.
    b. Software shall provide information on general system settings via mouse click on a floor plan. Left clicking over a device on the graphical software interface shall show a description of the selected device/function attribute.

6. Central Lighting Control:

    a. Shall provide an Interactive, Web-based graphical user interface (GUI) showing floor plans and lighting layouts that are native to the lighting control software. The only means required to program and operate the lighting control system shall be programmed and operated from a user interface that is based on a plan view graphical screen on the user's computer or the lighting control system's main computer. Shall include the navigational features listed below to allow for user's orientation within the controlled space, geographic heading and/or landmarks:

        1) Interactive
        2) Vector based
        3) Zoom
        4) Rotate
        5) Pan
        6) Tilt

    b. Shall allow building operator to navigate through an entire facility both in two-dimensional and three-dimensional multi-floor view, allowing for fast and easy navigation.
    c. Three-dimensional view shall exclude walls and other structural features to avoid shadowing and cluttering of the plan view.
    d. All programming, assignments of lighting loads to control strategies, lighting status and lighting energy reporting shall be native to the software and executed from this GUI. Editing shall be available from this GUI in a drag and drop format or from drop down menus without the need for any third party software. Systems that utilize or require third party linked graphics are unacceptable. The GUI shall continuously indicate the status of each connected device on the system and a warning indicator on the software if a device goes offline. Systems requiring spreadsheet editing for programming and that don't offer real time feedback are not acceptable.

e. Software settings and properties shall be selectable per individual device, room based, floor based or global building based.

1) Lighting Control Software interface shall provide current status and enable configuration of all system zones including selected individual fixture availability, current light level, maximum light level, on/off status, occupancy status, and emergency mode (response to an emergency signal) status.

f. Shall have the ability to display various lighting system parameters such as Lighting status (ON/OFF); Lighting levels, Load shedding status, or Lighting energy consumption, Occupancy status in a colorized gradient (“weather” map) type of graphical representation.
g. Energy Analysis data shall be exportable in a CSV or similar format.
h. Shall allow import of native AutoCAD files.

7. Reports: Reporting feature shall be native to the lighting control software and capable of reporting the following parameters for each device and zone individually without requiring any third party hardware and software:

a. Energy consumption broken down by energy management strategy.
b. Energy demand broken down by energy management strategy.
c. Occupancy data by zone.
d. Building wide occupancy status
e. Lighting energy consumption in a color gradient (“weather map” type) view
f. Energy performance reports shall be printable in a printer friendly format and downloadable for use in spreadsheet applications.

8. Personal Lighting Controls: The Personal Control Software interface shall provide current status and enable each user with the ability to dim and brighten lights, and turn them on and off by individual fixture or zone. The Software shall offer user configurable light scenes, which may be programmed and then selected via the Software. Personal lighting control shall be available in open/private office environments.
9. Daylight Harvesting (Light Regulation Averaging): In a photo sensor-equipped system, the Central Controller Unit shall rationalize changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions where dimming ballasts and/or drivers exist. Areas equipped with fixed output ballasts and/or drivers shall energize when natural light falls below foot-candle levels specified. System shall utilize light level inputs from common and/or remote sensor locations to minimize the number of photo sensors required. The System shall operate with multiple users in harmony and not react adversely to manual override inputs.
10. Time Clock Scheduling: The system shall be programmable for scheduling lights on or off via the Lighting Control Software interface.

a. Support for BACnet Time Schedule Object: This allows the export of Lighting Control time schedules to BACnet devices and vice versa in the event of Lighting Control System’s integration with BACnet.
b. Override: Manual adjustments via lighting controllers or personal control software shall temporarily override off status imposed by time clock schedule.
c. Response to Power Failure: In the event of a power failure, the time clock shall execute schedules that would still be in progress had they begun during the power outage.
d. Flick Warning: Prior to a scheduled lights-off event or expiry of a temporary override, the system shall provide two short light level drops as a warning to the affected occupants. Flick warning time shall have the ability to be programmed via software between one and five minutes.

11. Load Shed Mode: An automatic load shedding mode shall be available where, when activated through the system, the control unit will reduce its output to a programmable maximum electrical demand load. The system shall not shed more load than required and load shedding priority shall be centrally configurable by control zone or by common uses (i.e., all hallways can be treated as one load shed group), with subsequent load shed priority groupings being utilized until the required defined load has been shed, for either a defined period, or until the demand response input has been removed. Systems that simply select a “load shed scene” whereby there is no guarantee that the defined required load will actually be shed are not acceptable.
12. Emergency Mode: There shall be a mode, when activated through the system, that will immediately adjust lights to full light output and retain that level until the mode is deactivated in the event of an emergency. This setting shall override all other inputs. The system shall interface with the building of life safety transfer switch, fire alarm control panel, and security system control panel.
13. Addressing: All ballasts and/or drivers shall be centrally addressable, on a per fixture or multiple fixtures/zone basis, through the Central Control Software. The basis of design shall utilize industry standard 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers connected to an Output Module. To simplify ongoing maintenance, the system shall not require manual recording of addresses for the purpose of commissioning or reconfiguration.
14. Programmable Task Tuning: Maximum light level programmability shall be available by individual fixture.
15. Unoccupied State: The system shall provide two states when occupancy status is vacant as per an occupancy sensor: lights turn off or lights adjust to configurable (dimmed) light level.
16. Occupied State: The system shall be capable of creating “comfort” or “support” zones to ensure that occupants are not isolated by turning off lights in adjacent areas for occupant comfort and safety, such as a hallway path to exit the premises.
17. The Automated Lighting Control System (ALCS) BACnet Interface shall share the following information with the BACnet enabled Building Automation System and other systems listed below:

Property	BACnet Type	Description
Lighting Load	Analog Value*	Reports the total lighting load of the ALS, defined in Watts
Light Zone State	Binary Value*	State of the defined lighting zone - ON or OFF
Light Zone Dimming	Analog Value*	Light output level of the defined lighting zone, from 100 percent (maximum light output) to 0 percent (minimum light output)
Emergency System State	Binary Input	State of the emergency alarm system: alarm activated or alarm not activated
Fire Alarm State	Binary Input	State of the fire alarm system: alarm activated or alarm not activated

Security System State	Binary Input	State of security alarm system: alarm activated or alarm not activated
Occupancy State	Binary Output	State of the defined occupancy sensor – occupancy detected or not detected
Sheddable Load	Analog Output	Reports the total lighting load available for load reduction according to ALS, defined in Watts
Shed Status	Analog Output	Reports the total current load reduction achieved according to ALS defined prioritization, defined in Watts
Shed Request	Analog Input	Requested total amount of load reduction, defined in Watts or as a percentage of sheddable load
Sheddable Load (Group)	Analog Output	(As above, unprioritized for the selected group)
Shed Status (Group)	Analog Output	(As above, unprioritized for the selected group)
Shed Request (Group)	Analog Input	(As above, unprioritized for the selected group)

18. LAN Operations: System shall be capable of operating independent of building's existing network infrastructure if desired and shall not rely on tenant supplied PCs for operation. Network infrastructure shall only be utilized for Personal Control Software.
19. Firewall Security: Firewall technology shall be utilized to separate tenants from the lighting control network.
20. Lamp Burn In: The system software shall not permitt dimming of new lamps prior to completion of lamp manufacturer 100 hour recommended accumulated operation at full brightness.
21. Re-configurability: The assignment of individual fixtures to zones shall be centrally configurable by Central Control Software such that physical rewiring will not be necessary when workspace reconfiguration or re-zoning is performed. Removal of covers, faceplates, and ceiling tiles. shall not be required.
22. Automatic Control Parameters: Occupancy sensor time delays shall be configurable through software. Light level sensor parameters shall be configurable through software.
23. Automatic Time Adjustment: System shall automatically adjust for leap year and daylight savings time and shall provide weekly routine and annual holiday scheduling.
24. Contact closure input: System shall be capable of receiving a momentary and sustained contact closure input from third party sources to control lighting zones.
25. The light management system shall interface digitally with the building automation system via BACnet/IP and Tridium Niagara AX interface. The lighting control system shall

communicate the status of output devices (lighting loads) as well as input devices (dry contacts, switches, occupancy sensors, vacancy sensors, and photocells) over this connection allowing the building automation system to utilize lighting control system input devices such as occupancy sensors to determine if mechanical control zones are occupied for climate adjustments.

26. The system software shall provide a web based energy dashboard to show real time energy savings data and carbon footprint reductions.
27. Migration Plan to Control LED Fixtures

    a. System shall be capable of migrating from the control of 0-10V Ballasts to 0-10V LED Drivers utilizing the same Output Modules without the need to change control hardware.

L. Lighting Controllers

1. Description: The system shall include separate lighting controllers for each of the listed functionalities and at minimum meet listed electromagnetic, mechanical, electrical and data specifications:

    a. Software configurable lighting controller that provides on/off switching and dimming control for up to three lighting zones/scenes per controller or more with allowable multi-gang configurations. Status is indicated by an LED display to indicate function, scene or zone. Allows manual override of the time schedule.
    b. Manual dimming and/or switching lighting controller that provides local on/off and dimming control over at least three lighting zones. Allows manual dimming of light levels and override of the time schedule.
    c. Scenes in the central control software shall be synchronized with the buttons on the lighting controller.
    d. Lighting controllers shall fit in a standard Decorator style wall plate and may be ganged together.

2. General

    a. Addressing: All controllers shall be individually addressable & reconfigurable via Central Control Software.
    b. Shall provide local on/off or dimming control over lighting zones
    c. Shall utilizing a standard single-gang or multi-gang form factor
    d. Shall have a terminal block that connects to lighting system with 18 AWG, polarity independent , CMP rated and low voltage wire
    e. Shall be manufactured with push-in wire receptacles
    f. LED’s: All controllers shall feature LED’s to indicate light on and light off status.
    g. Color: All controllers shall meet NEMA WD1 color specifications.
    h. Style: All controllers shall feature Decorator styling wall plates.
    i. Lighting scenes reconfigure automatically based on scene changes from personal control software.
    j. Industrial lighting controllers shall also be available for damp location applications.
    k. Shall comply or exceed the following electromagnetic requirements:

        1) EN 61000-4-2
        2) EN 61000-4-4
        3) EN 61000-4-5
        4) FCC Part 15/ICES-003

3. Mechanical Specifications:

a. Dimensions: Shall meet NEMA WD-6 spec.
b. Maximum Operating Ambient Temperature: 60 deg C.
c. Mounts in standard size wall box suitable for multi gang installation or alternative of Low Voltage mounting bracket.
d. Suitable for use with Decorator style wall plates.

4. Electrical Specifications:

a. Class 2 Low Voltage device.
b. Power through interconnected 18 AWG cable with 2-pin header

5. Data Specifications:

a. Class 2 communication bus that uses prefabricated 18 AWG cable.

M. Wireless Site Lighting Control Module

1. The wireless site lighting control module shall extend the networked light management system's controls capability to a building's surroundings or site such as parking lots and short pathways, via a wireless mesh network based on Zigbee standards. The wireless site lighting control installs on top of a luminaire via an ANSI C136.41 compliance 7-pin twist-lock connector.
2. The wireless site lighting control shall be individually addressable via the wireless system management and can switch luminaires ON/OFF via an integrated high current relay, dim luminaires equipped with 0-10V dimming drivers or ballasts and has an input for an external occupancy sensor.
3. Specifications:

a. Power:

1) Operating voltage 120V-347V
2) Power consumption as no load: <1.0W
3) Surge protection: 6kV, 6kA

b. Load Rating: 10A: Electronic driver/ballast, magnetic ballast, resistive load
c. Interface:

1) Single dimming output that is 0-10V (IEC 60929 Annex E), DA-LI or DEXAL compatible.
2) Sink/source 10 mA
3) Senor Input: Maximum 20 mA; minimum 18; nominal 19.5V

d. Software:

1) Individual addressability
2) Time schedule based control
3) Daylight based control
4) Astronomical schedule based control
5) Occupancy based control

e. Power Metering

1) V, I, P Energy
   a) Accuracy is <2% from 0.5A to 10A load
   b) Accuracy is <5% below 0.5A

f. Environmental

1) Operational Temp: -40 deg. F to +150 deg. F (-40 deg. C to +65 deg. C)
2) Relative humidity: 0% to 95%
3) Ingress protection: IP66

g. Communication

1) Wireless protocol: ZigBee
2) Radio Frequency: 2.4 GHz
3) Transmit power: 20 dBm
4) Up to 1,000 ft. Line of sight between modules

h. Physical

1) Base diameter: 3.31 in. (84 mm); height: 2.61 in. (66.4 mm)
2) Weight: 0.44lbs (200g)
3) Color: black
4) Housing: UV stabilized PC

i. Regulatory

1) UL/916/773 cULus listed
2) Meets ASHRAE Standard 90.1 and CEC Title 24 requirements
3) FCC Part 15/ICES-003

N. Wireless Manager

1. The wireless manager shall collect, process and distribute lighting control information to control modules over a wireless mesh network. Each wireless manager typical can control up to 100 nodes.
2. The wireless manager is the central intelligence point in the system for the wireless devices. It collects signal information from control modules, it then determines appropriate brightness levels or ON/OFF status for each fixture and zone.
3. Specifications:

a. Wireless Range: 100 ft. line of sign, 50 ft through standard walls
b. Wireless manager Network Port – Ethernet 1-/100BaseTx Cat. 5 RJ45 port
c. Dual PoE ports for daisy chain of up to 3 wireless managers
d. Status LED on front of unit
e. Configuration stored in non-volatile flash memory
f. Weights: 115g (4.06oz) wireless manager 40g (1.41 ox) ceiling mounted kit
g. Operating temperature range: 32 deg. F to 104 deg. F (0 deg. C to 40 deg. C)
h. AES 128-bit encryption for wireless communication
i. Dimensions: 2.81 in. W x 4.631 in. H x 0.78 D (71.37mm W x 117.6mm H x 19.81mm D)
j. Includes Polaris 3D software
k. cULus Listed

1) Energy Management Equipment (UL 916)

l. Complies with the following electromagnetic requirements:

1) EN 61000-4-2
2) EN 610000-4-4
3) EN 610000-4-5

m. FCC Part 15/ICES-003

O. System Field Devices (Input and Output Modules)

1. General: Input Modules provide a common interface to low voltage occupancy sensors and photo sensors while Output Modules provide a common interface to 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers and analog dimming devices such as incandescent low-voltage dimming modules. These modules automatically self-address and detect the type of devices they are connected to (i.e., photo sensor, occupancy sensor, 0-10V ballast, 0-10V LED drivers or incandescent dimming module) and establish two-way communication between the system Control Unit (CU) and themselves. These individually addressable modules enable each lighting component to be independently controlled and configured to best meet the needs of the facility.

a. Addressing: System Field Devices shall be individually addressable via Central Control Software.
b. System shall automatically address individual nodes during system commissioning thus eliminating the need to pre-address devices or record serial numbers during installation.
c. Modules shall at minimum meet the listed general, mechanical and environmental specifications set at below.

2. Provide Wireless site lighting control (WSLC) module for all site lighting unless specifically noted on the electrical site plan.
3. Air Gap Off

a. Definition: Air Gap Off shall refer to the physical disconnection of AC power to the ballast or driver when “OFF” is selected either automatically or manually, thus ensuring maximum energy savings by eliminating off-state phantom power losses as well as ensuring that no potentially lethal high-voltage is present at the ballast or driver when the lights appear to be off (for life-safety reasons).
b. Provisions: Provide an air-gap off relay for each control zone in the system. Where each fixture is to be controlled (dimmed and/or switched) independently, provide one relay per fixture. Where multiple fixtures are to be controlled (dimmed and/or switched), provide one relay per control zone, sized to handle both the inrush current as well as the maximum connected load, at the specified voltage.

4. General Specifications:

a. Shall supply 12VDC (up to 24VDC) to sensors.
b. Shall have 2 ports that accept 18 AWG, pre-fabricated, polarity independent quick connecting Class 2 communication bus that supplies 24 VDC.
c. Two models, one rated for regular indoor use and other for use in damp locations such as basements, cold storage areas. shall be available.
d. Memory: Retains all system settings in non-volatile memory.

5. Mechanical Specifications:

   a. Wiring: The System Field Device shall not require wiring connections to the System apart from pre-terminated, quick connecting 18 AWG, polarity independent quick connecting Class 2 communication bus.

6. Environmental Specifications:

   a. Operating Temperature Range: -40 deg C to +55 deg C.
   b. Humidity: 0 percent to 100 percent RH condensing rated for damp locations. 0 percent to 95 percent RH non-condensing rated for indoor locations.

P. Energy Control Unit

1. General: The Energy Control Unit (ECU) is a rack or wall mounted lighting control device that collects, processes and distributes lighting control information to System Field Devices and lighting controllers over a Class 2 communication bus. Each ECU has multiple Class 2 communication channels and can control a large quantity of nodes (sensors, lighting controllers, 0-10V Dimming, Fixed Output Ballasts and 0-10V LED Drivers.) per channel, per the manufacturers recommended maximum. The ECU is the central intelligence point for the area that it controls, collecting signal information from sensors, lighting controllers and personal control software and determining appropriate brightness levels or on/off status for each fixture or zone. Each ECU has an Ethernet connection for communication with a facility's or tenant's Local Area Network (LAN) to enable desktop personal control.

   a. Shall interconnect with other ECUs and System Server Unit (SSU) using standard Ethernet connection that employs TCP/IP protocol.
   b. Control units shall at minimum meet the mechanical, electrical, data, electromagnetic and environmental specifications listed below.

2. Mechanical Specifications:

   a. Shall mount in a standard 1 inch rack (1U width), or alternatively where no rack is shown, via an individual wall mount.

3. Electrical Specifications:

   a. Power Supply: 120V/60Hz/200W. Provide dedicated 120V receptacle fed from a dedicated normal power circuit; do not connect to a UPS or normal/emergency power source.

4. Data Specifications:

   a. Shall have 8 ports that accept 18 AWG, pre-fabricated, polarity independent quick connecting Class 2 communication bus that supplies 24 VDC
   b. Each ECU channel shall support up to 100 nodes or 800 nodes in total.
   c. Each ECU shall have two Ethernet 10/100Base - Tx Cat 5 RJ45 ports that employs TCP/IP protocol:

      1) Lighting Control Network
      2) Tenant LAN Access Point

   d. Shall have a status LED on front of unit.
   e. Shall have configuration stored in non-volatile flash memory.

5. Shall comply or exceed the following electromagnetic requirements:

    a. EN 61000-4-2
    b. EN 61000-4-4
    c. EN 61000-4-5
    d. FCC Part 15/ICES-003

6. Environmental Specifications:

    a. Operating Temperature Range: -20 deg C to +40 deg C.
    b. Humidity: 0 percent to 95 percent RH non-condensing.

Q. System Server Unit

1. General: System Server Unit (SSU) shall host the lighting control system database for all the lighting control devices. Server shall have the ability to:

    a. Remotely access a system in order to change system settings or configuration;
    b. Analyze system performance or energy data or generate system report;
    c. Record energy consumption with average sampling every 5 minutes for unlimited duration;
    d. Host the web interface required for the web enabled Personal Control Software or web based Central Control Software;
    e. Optionally can reside on a client server (virtual server) thus eliminating the need for dedicated physical hardware if desired;
    f. Interconnect with ECUs over standard Ethernet connection that employs TCP/IP protocol;

2. Hardware based servers shall at minimum meet the specifications listed below:

    a. Specifications:

        1) Mechanical Specifications:
            a) Shall mount in a standard 19 inch rack (1U width), or alternatively where no rack is shown, via an individual wall mount.

    b. Electrical Specifications:

        1) Power Supply: 120V/60Hz/200W. Provide dedicated 120V receptacle fed from a dedicated normal power circuit.

    c. Regulatory:

        1) FCC (US only) Class A.
        2) DOC (Canada) Class A.
        3) UL 60950.
        4) CAN/CSA-C22.2 No. 60950.

R. Communication Wire

1. Wiring: 18 AWG, pre-fabricated, polarity independent quick connecting wiring. The system shall have the capability to use both Class 1 and Class 2 wiring. The maximum connected length of wiring shall be 2500 ft. per channel.
2. Field Bus: Integrates peripheral devices such as 0-10V ballasts and/or 0-10V LED drivers, occupancy sensors, photo sensors, relay-based controls, power packs and low voltage wall controls into a complete, networked programmable lighting control system. Provides power to photo sensors, PIR occupancy sensors and dual-technology occupancy sensors. Devices may be connected randomly on the network and special termination of each network channel is not required.
3. Field bus shall at minimum meet the specifications listed below:

    a. Specifications:

        1) Class 2 communication bus.
        2) Prefabricated one ft., five ft., ten ft., 15 ft., 20 ft., 25 ft. and 50 ft. lengths.
        3) Daisy chain topology
        4) Prefabricated with 2-wire connectors.
        5) Flame rated jacket for plenum use NFPA 262 (UL: FT6, CSA: CMP).
        6) Power Supply: 12 VDC (up to 24 VDC) to sensors.

S. Conductors and Cables

1. Class 2 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG.

T. Lighting Control Panels

1. General

    a. Addressing: All lighting control panels shall be individually addressable via Central Control Software.
    b. Communication: All lighting control panels shall communicate via the same prefabricated, quick connecting low voltage wiring as all other devices.
    c. Wiring: Relay control panels shall be interconnected on the same field bus as all other system components.

U. Lighting Control System Software

1. Personal Control Software: Enables individuals in a building to control lighting levels in their workspace from their own desktop PC. User can control the light level of each fixture in their workspace or can control all of the fixtures together as a group. Preset lighting scenes may be stored, recalled and modified. This software shall have the capability of acting as a “virtual occupancy sensor” for the system by detecting keyboard or mouse activity on each PC for incremental occupancy status data.

    a. Technical Information:

        1) TCP/IP network traffic < 2kb/s.

2. Web based Personal Control Software: This feature allows individuals to control lighting levels in their workspace without the requirement for installation of software on client PCs. Individuals can access the interface through the web browser and perform individual fixture dimming control, on/off switching, modify and save preset lighting scenes.
3. Technical Information: Adobe Flash ® based user interface.

    a. System Requirements:

        1) Internet web browser with Flash® Player 8 or later.
        2) Internet/Intranet connection.
        3) SSU enabled and configured to host dynamic website.
        4) Network connection with access to a network-enabled CU.

4. Web based Central Control Software: Central control software application is used to commission, configure and manage the system. Every system parameter in a building (or campus of buildings) is configured for each individual user or space and baseline settings are established for each of the following (depending on the basis of design) system features:

    a. Daylight harvesting.
    b. Occupancy control.
    c. Smart time scheduling.
    d. Task tuning.
    e. Personal control.
    f. Load shedding.

        1) Software utilizes a web based interface that permits a user to easily navigate between zones, floors or different buildings and allows a user to zoom in or zoom out of specific areas of a building. Both 3-dimensional and 2-dimensional multi-floor views shall be available. System features such as creation of zone hierarchies, overlapping and support zone definitions, user access rights, timeout settings for occupancy sensors, calibration of light levels for daylight harvesting and the configuration of multiple time schedule profiles shall be available.
        A web based Graphical User Interface (GUI) application integral to the system will be used to develop a dynamic, real-time, point-and-click graphic of each floor plan with representation of all light fixtures, lighting controllers, sensors, and switches. A central system server will be provided to support system data base and enterprise control management.

5. System Requirements:

    a. Software must be able to run on a Windows Operating systems (Windows XP or newer) and also on Apple Mac Intel PCs (Mac OS 10.4 or newer).
    b. Must support all common browsers, i.e.,

        1) Internet Explorer 6.0 or later
        2) Mozilla Firefox 3.0 or later
        3) Safari
        4) Google Chrome

    c. Network connection with access to network-enabled CUs.
    d. Color gradient (“weather map” type) data view (see below for an example) shall be available to display the following criteria:

1) Current energy consumption
2) Current energy savings
3) Current fixture brightness
4) Current fixture status
5) Current occupancy data
6) Current load shedding status
7) Other custom modes that may be specified elsewhere

V. Photo Sensor:

Photo sensors shall at minimum meet the specifications listed below:

1. General Specifications:

a. Shall be Class 2, low voltage.
b. Ambient light sensor designed to interface directly with the analog input of the Lighting Control System.
c. Sensor shall supply an analog signal to the ALCS proportional to the light measured.
d. Sensor output shall provide for zero or offset based signal.
e. Sensor shall be capable of a fully adjustable response in the range between 0 and 10,000 foot candles with a +/- 1 percent accuracy at 70 deg F.
f. Input: 10VDC.
g. Minimum Output: 0 VDC.
h. Maximum Output: 10 VDC.
i. Sensor housing shall be flame retardant and meet UL 94 HB standards.
j. Operating Temp: -10 deg C to 60 deg C.
k. The sensitivity adjustments shall be at sensor body, and outside of the sensor's viewing angle.
l. The sensor houding shall be flame retardant and meet UL 94HB standards

2. Interior:

a. Indoor sensors shall have a Fresnel lens, with a 60 degree cone of response. The indoor sensor range shall be between 0 and 750 FC.

3. Exterior:

a. Outdoor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. The Outdoor sensor range shall be between 0 and 750 FC.

4. Atrium:

a. The Atrium sensors shall have a translucent dome with a 180 degree field of view. Atrium sensor shall mount to a standard treaded 1/2 in. conduit or fit a 1/2 in. knockout. Atrium sensor range shall be from 2 to 2,500 FC.

5. Skylight:

   a. The Skylight sensors shall have a translucent dome with a 180 degree field of view. Skylight sensor shall mount to a standard treaded 1/2 in. conduit or fit a 1/2 in. Skylight sensor range shall e between 10 and 7,500 FC.

W. Occupancy Sensors

1. Environmental:
   Operating Temperature Range: 0ºC to 40ºC

   a. Relative Humidity: 0 percent to 95 percent non-condensing
   b. Ceiling Mount Occupancy/Vacancy Sensors

      1) Sensing mechanism:
      2) Dual technology (ultrasonic / passive infrared):
      3) Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
      4) Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.
      5) Electrical: Rating: 12 VDC input voltage, up to 40 mA current draw.
      6) Sensors shall turn off or reduce lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space
      7) Sensor shall accommodate all conditions of space utilization and all irregular work hours and habits.
      8) Sensors shall be UL listed.
      9) Sensors shall be fully adaptive and adjust their sensitivity and timing to ensure optimal lighting control for any use of the space
      10) Sensors shall have field adjustable controls for time delay and sensitivity to override any adaptive features. Sensor timeouts shall be configurable by System software.
      11) Power failure memory:
      12) Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and learned parameters saved in protected memory shall not be lost.
      13) Provide all necessary mounting hardware and instructions.
      14) Sensors shall be Class 2 devices.
      15) Indicate viewing directions on mounting bracket for all Ceiling mount sensors.
      16) Provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology. Field prepare proper maskings for each space to eliminate unnecessary sensing beyond the space in which the sensor is located.
      17) Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

X. Examination

1. Site Verification: Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer’s instructions.
2. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

Y. Installation

1. The Electrical Sub-contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Sub-contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control as described herein and shown on the plans (including but not limited to System Field Devices, 0-10V dimming ballasts, fixed output ballasts, 0-10V LED drivers and communication wire). The Electrical Sub-contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.
2. Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.
3. Related Product Installation: Refer to other sections listed in Related Sections for related products' installation.

Z. Sensor Installation

1. Adjust sensitivity to cover area installed
2. Set time delay on occupancy sensors that are connected to the lighting control system to the minimum. Time delays shall be controlled via Central Control Software.
3. Sensor shall be powered through Input Module. No external power packs shall be used for powering sensors.
4. Install occupancy sensors on vibration free stable surface.
5. Install atrium and skylight light sensor facing toward window or skylight.
6. Install interior light sensor in ceiling facing the floor.

AA. Wiring Installation

1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
2. Wiring within Enclosures: Comply with NEC & CEC. Separate power-limited and non power-limited conductors according to conductor manufacturer's written instructions.
3. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

BB. Software Installation

1. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current site licenses for software.

CC. Field Quality Control

1. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

2. Perform the following field tests and inspections with the assistance of a factory-authorized service representative:

    a. Operational Test: After installing lighting controllers and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
    b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Lighting control devices will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

DD. Coordination with the owner

1. Owner meeting: The manufacturer shall supply factory trained representatives for a minimum of 16 hours (2) 8 hour sessions with the owner to review and complete the system programming data sheet and controllability of the system. The Sequences as designed and shown on the contract documents shall be outlined and explained to the owner and any input/changes from the owner shall be incorporated as long as overrides of energy code mandated controls are not suggested.

EE. Commissioning Requirements

1. Commissioning: The manufacturer shall supply factory trained representatives for a minimum of 24 hours to commission the lighting control system. Manufacturer shall start up all lighting control equipment and verify that it meets the requirements of this specification.
2. Training: As part of the standard commissioning process, the manufacturer shall train the owner's representatives in the operation of the system to a maximum of 4 hours per building. Manufacturer shall also provide owner's representatives with system operating manuals together with a system training video. Specific training on the operation of the tunable white lighting shall be provided. In addition to the 4 hours an additional 4 hours of training shall be provided for spaces utilizing tunable white light.
3. Technical Support: The manufacturer shall supply 24/7 technical telephone support to the client. If the manufacturer does not provide 24/7 support, they must provide a list of contacts (names and cell phone numbers) in the event of a system failure during non-business hours.
4. Replacement components: The manufacturer shall be able to ship replacement parts within 24 hours for any component that fails during the warranty period.
5. Extended Service Coverage: Maintenance agreements shall be available from the manufacturer to provide service for the system both during and after the warranty period.
6. Requests for commissioning shall be at least two weeks prior to date desired for commissioning.
7. Electrical Sub-contractor shall perform functional testing under the guidance of commissioning agent and in accordance with factory specified guidelines.
8. Factory appointed personnel shall provide commissioning services for the lighting control system.

    a. Verify proper communication over control wires.
    b. Map addresses of occupancy sensors (via Input Modules), light level sensors (via Input Modules), lighting controllers to control units and system server.
    c. Map all system data to appropriate BACnet points and assist BMS sub-sub-contractor in programming all points into the BMS system and verifying their proper functionality.
    d. Verify communication to control units and system server.

e. Configure occupancy sensors, light level sensors, lighting controllers and other contacts to suit design specifications.
f. Configure and program lighting control sequences as described on contract documents.
g. Demonstrate to Owner and Engineer proper operation of all areas the system is installed.

FF. Testing

1. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely configure and test the system.
2. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

GG. Demonstration

1. Engage a factory-authorized service representative to train Owner's maintenance personnel and building supervisors to adjust, operate, utilize, troubleshoot, conduct software installation, and maintain lighting controls and software training for PC-based control systems. Provide up to eight hours of on-site training with audio and video recorded. Provide a hard copy of manuals, instructional videos, and recorded training session(s) on CD or DVD.
2. Submit shop drawings indicating outline dimensions, connection and support points, weight, specified ratings and materials.
3. Submit product data indicating standard model design tests and options.
4. Submit manufacturer's installation instructions.

HH. OPERATION AND MAINTENANCE DATA

1. Submit operation and maintenance data under.
2. Include procedures for cleaning unit, and replacing components.

II. QUALITY ASSURANCE

1. Manufacturer: Company specializing in distribution transformers with Five years Documented experience.

2.19 LADDER TRAY/WIREWAYS

A. Provide ladder tray where indicated on drawings. Ladder tray shall be as manufactured by b-line, "ladder type", or equal. Provide all hangers required.

B. Wireway:

1. This specification covers NEMA type 1 wireway used to house ad protect communication cable. The wireway system shall consist of wireway and appropriate fittings to complete the installation per the electrical drawings.
2. Metal wireway (NEMA type 1) is to be utilized in dry interior locations only as covered in article 362 part a of the national electrical code, as adopted by the national fire protection association and as approved by the American National Standards Institute. The wiremold c" or "sp" series is listed by underwriters' laboratories under file no. E137690 guide zoyx.
3. The wireway system specified herein shall be the "c" or "sp" system as manufactured by the wiremold company. Systems of other manufacturers may be considered equal if, in

the opinion, and the written approval of the engineer, they meet all the performance standards specified herein.

4. The wireway and all system components must be UL Listed in full compliance with their standard ul870, “electrical wireways, auxiliary gutters and associated fittings”. It shall be manufactured from 16-gauge cold rolled steel, finished in ASA 61 gray powder coat paint. All sizes larger than 6 in. x 6 in. shall be manufactured from 14-gauge cold rolled steel, finished in ASA 61 gray powder coat paint. A factory installed divider shall be available to separate power and low voltage wring housed n the same wireway sections.
5. A full complement of fittings for the raceway shall be available including, but not limited to, 45 deg. and 90 deg. flat, vertical inside and outside elbows, tee and cross fittings, couplings for joining sections of wireway, reducers, hangers, end blanks, a field installed divider and all other components necessary to make the system workable. The fittings shall have an ASA 61 gray powder coat paint finish to match the wireway.
6. Prior to and during installation, refer to system layout drawing containing all elements of the system. Installer shall comply with detailed manufacturer’s instruction sheets which accompany system components as well as complete system instruction sheets, whichever is applicable.
7. All wireway systems shall be mechanically continuous and connected to all electrical boxes and cabinets, in accordance with manufacturer’s installation sheets.
8. All connections shall be checked to make sure they are correctly tightened and to insure that all wireway shall be electrically continuous and bonded in accordance with the national electric code for proper grounding.
9. All wireway systems shall be installed complete. Work shall include fastening all wireway and appropriate fittings to install a complete wireway system as indicated on the electrical and/or communication drawings and in the applicable specifications

2.20 UNINTERRUPTIBLE POWER SUPPLY (Size as indicated on the drawings)

A. General

1. This specification describes a continuous duty, three-phase, solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS. The UPS shall contain a full rated input rectifier / boost converter (hereafter referred to as Input Converter), output inverter, and 10 percent battery charging circuit. The system shall also contain a continuous duty bypass static switch, internal mechanical bypass, removable hot swap battery plant, and LCD interface display. Maintenance bypass and extended battery is required to meet this specification shall be contained in matching enclosures with all interconnecting cabling included. All programming and miscellaneous components for a fully operational system as described in this specification shall be provided as part of the UPS.

B. Standards

1. The UPS shall meet the requirements of the following standards:

   a. IEEE 587-1980/ANSI C62.41 1980 Standards for Surge Withstand Ability.
   b. FCC rules and regulations of Part 15, Subpart J, Class A.
   c. UL listed under 1778, Standards for Uninterruptible Power Supply Equipment.
   d. UL Canada (cUL).
   e. NEMA PE 1 (National Electrical Manufacturers Association) - Uninterruptible Power Systems.
   f. NEMA 250 (National Electrical Manufacturers Association) – Enclosures for Electrical Equipment (1000 Volts Maximum).
   g. IEEE 519-1992 Standard Practices and Requirements for Harmonic Control in Electrical Power Systems

h. NFPA 70 – National Electrical Code.
i. ISO 9001.
j. ISO 14001
k. Occupational Safety & Health Administration (OSHA).

C. Submittals

Submittals shall contain the following documentation:

1. Installation Drawings: Indicate electrical characteristics and connection requirements. Provide cabinet dimensions; battery type, size, dimensions, and weight; detailed equipment outlines, weight, and dimensions; location of conduit entry and exit; single-line diagram, control, and external wiring requirements; heat rejection, full and part load efficiencies and air flow requirements.
2. Product Data: Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.

D. Warranty

1. UPS Module: The UPS shall be covered by a full parts and labor warranty from the manufacturer for a period of twelve (12) months from date of acceptance by customer.
2. Battery: The battery manufacturer's warranty shall be passed through to the final customer and shall have a minimum period of one year.

E. Maintenance, Accessibility and Self Diagnostics

1. All UPS subassemblies, as well as the battery, shall be accessible from the front. UPS design shall provide maximum reliability and minimum MTTR (mean time to repair). To that end, the UPS shall be equipped with a self-test function to verify correct system operation. The self-test function shall identify the subassembly-requiring repair in the event of a fault. The electronic UPS control and monitoring assembly shall therefore be fully microprocessor based, thus doing away with all potentiometer settings. This shall allow:

   a. Auto-compensation of component drift;
   b. Self-adjustment of replaced subassemblies;
   c. Extensive acquisition of information vital for computer-aided diagnostics (local or remote);
   d. A socket for connection to a computer-aided diagnostics system.

2. The UPS shall be repairable by replacing standard subassemblies requiring no adjustments or settings. Communication with a remote maintenance system shall be possible.

F. System Description and Operation

1. Approved Manufacturer(s): The specified equipment shall be manufactured by Eaton, Liebert, Mitsubishi, or equal.
2. UPS Design Requirements

   a. Output Power Continuous Rating: The continuous output power rating of the UPS shall be shall 24KW, 30 kVA at a 0.8 lagging power factor.
   b. Input Voltage: 120/208 VAC – 25 percent / +15 percent, 3 phase, 4 wire plus ground.
   c. Output voltage: 120/208 VAC 3 phase, 4 wire plus ground.

d. Battery Autonomy: The UPS have battery strings such that it shall be capable of operating at full load for (30 minutes) at 0.8 PF output at a temperature of 25°C on battery power.
e. Battery Type: Hot swappable valve regulated sealed lead acid (VRLA).
f. AC Input Characteristics.

1) Input Frequency: 60 Hz (- 25 percent to + 15 percent)
2) Maximum Input Current at Low Line Voltage: 51 A with 125 percent continuous overload.
3) Input Power Factor: > .98 lagging for loads greater than 50 percent and > .95 for loads greater than 15 percent.
4) Harmonic Distortion of Input Current Wave Form: less than 5 percent at full load.

g. Power walk-in: Linear 0 to 100 percent over a 15-second period.
h. Magnetizing Inrush Current: Less than nominal input current for less than one cycle.

3. AC Output Characteristics.

a. Voltage Regulation: + 1.0 percent for balanced load; + 1.75 for 50 percent unbalanced load; + 2.5 percent for 100 percent unbalanced load
b. Frequency: 60 Hz +1 percent (or selectable up to 4 percent). 60 Hz + 0.1 percent when free running.
c. Voltage Distortion: Maximum 2 percent total (THD) and 1 percent any single harmonic on 100 percent linear loads.
d. Voltage Transient (Step Load) Response:

1) + 3 percent for 50 percent step load change
2) + 5 percent for 100 percent step load change
3) + 1 percent for loss or return of AC input power or manual transfer at full load.

e. Voltage Recovery Time: Return to within 1 percent of nominal value within 50 milliseconds.
f. Phase Angle Displacement: 120 deg. + 1 deg. degrees for balanced load; 120 deg. + .3 deg. degrees for 100 percent unbalanced load
g. Non-Linear Load Capability: Output voltage total harmonic distortion shall be less than 3 percent when connected to a 100 percent non-linear load with a crest factor not to exceed 3.0.
h. Slew Rate: 1 Hz/second maximum (or selectable up to 2.0 Hz/sec).
i. Power Factor: 0.8 at the rated volt-amperes (VA)
j. Inverter Overload Capability:

1) 120 percent of rated load for 1 minute
2) 145 percent of rated load for 30 seconds
3) Bypass Overload Capability: > 800 percent for 500 milliseconds, 125 percent continuous.
4) Overall AC to AC efficiency with fully charged battery 93.0 percent at full load and 93.4 percent at 50 percent load.

4. DC Bus.

a. Normal DC voltage 192VDC.
b. Maximum DC current at cutoff voltage will be 43.3 A.

c. End of discharge 152VDC

5. Modes of Operation.
The UPS module shall be designed to operate as a double conversion, on-line reverse transfer system in the following modes.

a. Normal: The input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.
b. Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.
c. Recharge: Upon restoration of the AC input source, the input converter and output inverter shall simultaneously recharge the battery and provide regulated power to the critical load.
d. Static Bypass: The static bypass shall be used to provide transfer of critical load from the Inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function.
e. Internal Mechanical Bypass: As a standard feature, the UPS shall be equipped with an internal, make before break, bypass switch. This switch shall mechanically bypass the UPS for times where maintenance is required.

6. Component Description.

a. Rectifier / Battery Charger: The input power converters of the system shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and Main Inverter regulated output power.:

1) Soft-Start Operation: As a standard feature, the UPS shall contain soft-start functionality, capable of limiting the input current from 0-100 percent of the nominal input over a default 15 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation. (di/dt= constant)
2) Input Current Total Harmonic Distortion: The input current THDI shall be held to 5 percent or less at full system, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.
3) The input converter shall control and limit the input current draw from utility to 150 percent of the UPS output. During conditions where input current limit is active, the UPS shall be able to support 100 percent load, charge batteries at 10 percent of the UPS output rating, and provide voltage regulation with mains deviation of up to +/-15 percent of the nominal input voltage.
4) Modular Assembly: The rectifier/battery charger assembly shall be constructed of modular design to facilitate rapid maintenance.
5) Charging Levels: The battery charging shall keep the DC bus float voltage of +/- 220v, +/-1 percent

6) Battery Charge Current Limit: The UPS shall be capable of limiting the energy sourced from the mains for purposes of battery charging. As a default setting, the battery charge energy will be set to 100 percent of its nominal value. When signaled by a dry contact, (such as from an emergency generator) the UPS shall be capable of limiting the battery charge energy taken from the mains. This shall take place in user selectable increments of 75 percent, 50 percent, 25 percent, 10 percent and 0 percent of the nominal charge power. The selection shall be made from the UPS front panel display/control unit.
7) Temperature Compensated Charging: The battery charger shall be equipped with a temperature probe to enable temperature compensated charging and adjust the battery float voltage to compensate for the ambient temperature using a negative temperature coefficient of 3 mV per cell per degree Celsius at a nominal temperature of 25°C.
8) Capacity: The rectifier/battery charger shall have sufficient capacity to support a fully loaded inverter and fully recharge the battery to 95 percent of its full capacity within 6-8 hours.

b. Inverter: The UPS output shall be derived from a Pulse Width Modulated (PWM) IGBT inverter design. The inverter shall be capable of providing the specified precise output power characteristics (specified in section 2.2.C) while operating over the battery voltage range. The inverter assembly shall be constructed as a modular assembly to facilitate rapid maintenance.
c. Static Bypass: As part of the UPS, a system static bypass switch shall be provided. The system static bypass shall provide no break transfer of the critical load from the Inverter output to the static bypass input source during times where maintenance is required, or the inverter cannot support the critical bus. Such times may be due to prolonged or severe overloads, or UPS failure.

7. Uninterrupted Transfer: The static bypass transfer switch shall automatically cause the bypass source to assume the critical load without interruption after the logic senses one of the following conditions:

a. Inverter overload exceeds unit's rating.
b. Battery protection period expired and bypass current is available.
c. Inverter failure.

8. Interrupted Transfer: If the bypass source is beyond the conditions stated below, the UPS will make an interrupted transfer (not less than 500 msec. in duration).

a. Bypass voltage greater than + 10 percent, -10 percent from the UPS rated output voltage.
b. Bypass frequency greater than + 2 Hz from the UPS rated output frequency.

9. Automatic Uninterrupted Forward Transfer: The static bypass transfer switch shall automatically forward transfer power from the bypass to the rectifier / inverter, without interruption, after the UPS inverter is turned "ON", after an instantaneous overload-induced reverse transfer has occurred and the load current returns the UPSs nominal rating or less.
10. Manual Transfer: A manual static transfer shall be initiated from the UPS Control Panel by turning the UPS inverter off.
11. Overload Ratings: The static bypass transfer switch shall have the following overload characteristics after which time a thermal protection device will engage to protect the static bypass.

a. 800 percent of UPS output rating for 0.5 seconds (one cycle).
b. 150 percent for 30 seconds.

c. 125 percent of UPS output rating continuous.
d. Microprocessor Controlled Logic.

1) The full UPS operation shall be provided through the use of microprocessor controlled logic. All operation and parameters are firmware controlled, thus eliminating the need for manual adjustments or potentiometers. The logic shall include a self-test and diagnostic circuitry such that a fault can be isolated down to the printed circuit assembly or plug-in power assembly level. Every printed circuit assembly or plug-in power assembly shall be monitored. Diagnostics shall be performed via a PC through the local diagnostics port on the UPS.

G. System Controls and Indicators

1. Display Unit: A microprocessor controlled display unit shall be located on the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches. The following metered data, shall be available on the alphanumeric display:

a. Measurements, status indications and events.
b. Event log with time stamping.
c. Access to all measurements.

2. System Parameters Monitored (data displayed): The visual display will display the following system parameters based on true RMS metering:
3. Measurements:

a. Year, Month, Day, Hour, Minute, Second of occurring events.
b. Source Input Voltage
c. Input Frequency
d. Output AC voltage
e. Output AC current

4. Status indications and events:

a. Static bypass switch on
b. EPO Active
c. Mechanical bypass activated
d. External bypass switch (Q3) activated
e. Battery discharged
f. Return from low battery
g. Low battery
h. Load not powered from UPS
i. UPS in bypass
j. Runtime calibration aborted
k. Runtime calibration started
l. Runtime calibration complete
m. Battery self-test aborted
n. Battery self-test started
o. Battery self-test completed
p. Number of battery modules decreased
q. Number of battery modules increased
r. Fan fault
s. SBS fault
t. System not in sync.

u. Bypass not available, frequency/voltage out of range
v. Mains voltage/frequency out of range
w. Site wiring fault
x. Low battery voltage shut down
y. Defective battery detected
z. Runtime is below alarm threshold
aa. Load is above alarm threshold
bb. Battery over-voltage warning
cc. Battery over-temperature warning
dd. Emergency power supply fault
ee. Output overloaded

1) Time-stamped historical events: This function shall time-stamp and store all important status changes, anomalies and faults and make this information available for automatic or user-requested consultation; it shall interpret the events and indicate remedial measures if applicable.

5. Push Button User Controls

a. Up Arrow
b. Down Arrow
c. Help Key
d. Escape Key
e. Enter Key

6. Emergency Power Off (EPO): The UPS shall be equipped with a local emergency power off button and dry contact input that can be used to command UPS shut down remotely. Activation of this command shall lead to the following actions:

a. Inverter shutdown
b. Opening of the static bypass switch and the battery circuit breaker
c. Opening of an isolated dry contact on the programmable relay board

7. RJ-45 Interface port for remote communications with a network via web browser or SNMP, or APC InfraStruXure Manager.
8. Dry Contacts: The UPS shall be provided standard with a programmable input/output relay board. This board shall have 8 dry contacts, i.e. 6 for input signals and 2 for output signals. Contacts shall be programmed as:

a. Low battery
b. Load on battery power
c. Load on automatic bypass
d. Load on UPS
e. Common Fault
f. UPS Off

1) The contacts will be programmable normally open or normally off and will change state to indicate the operating status. The contacts will be rated at 2.0 A (250 VDC / 30 VDC).

H. Mechanical Design and Ventilation

1. Enclosure: The UPS shall be housed in a freestanding enclosure with dead front construction. The mechanical structure of the UPS shall be sufficiently strong and rigid to

withstand handling and installation operations without risk. Access to UPS subassemblies shall be through the front or top. The sheet-metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, bichromating, epoxy paint or an equivalent.

2. Cable Access: The standard UPS shall accommodate top or bottom entry cables.
3. Cabinet Weights and Dimensions: The width of the UPS System is 32.8 (in Inches) and has an approximate weight of 1050 lbs.
4. Ventilation and Heat Rejection: The UPS shall be designed for forced air-cooling. Air inlets shall be provided from the front bottom of the UPS enclosure. Air exhaust shall be from the top rear portion of the unit. Full load heat rejection is 4777 BTU /hour.

I. Battery

1. The UPS battery shall be of modular construction made up of user replaceable, hot swappable, fused, battery modules. Each battery module shall be monitored to determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.
2. The battery jars housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type.
3. The UPS shall incorporate a battery management system to continuously monitor the health of each removable battery module. This system shall notify the user in the event that a failed or weak battery module is found.

J. Accessories

1. External Control and Communications Devices
   The following control and communications devices shall be provided in the UPS module.

2. Network Adaptor:
   The Ethernet Web/SNMP Adaptor shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and UNIX "tar" formats. The SNMP interface adaptor shall be connected to the UPS via the RS232 serial port on the standard communication interface board.
   The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems during when the UPS is on reserve mode.
   The UPS shall also be capable of using an RS232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during an on battery situation.

3. Remote UPS Monitoring

   a. The following three methods of remote UPS monitoring shall be available:

      1) Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.
      2) RS232 Monitoring: Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.
      3) Simple Network Management Protocol (SNMP): Remote UPS Monitoring shall be possible through a standard MIB II compliant platform.

K. Connect UPS monitoring system to Owner’s communications room computer system. Provide all wiring in conduit. Coordinate with Owner for tie-in point.

L. Factory Assisted Start-Up

1. Factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

   a. Visual Inspection:

      1) Inspect equipment for signs of damage.
      2) Verify installation per manufacturer's instructions.
      3) Inspect cabinets for foreign objects.
      4) Inspect Battery Units.
      5) Inspect Power Module(s).

   b. Mechanical Inspection:

      1) Check all UPS and external maintenance bypass cabinet internal power wiring connections.
      2) Check all UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.

   c. Electrical Inspection:

      1) Verify correct input and bypass voltage.
      2) Verify correct phase rotation of all mains connections.
      3) Verify correct UPS control wiring and terminations.
      4) Verify voltage of all battery modules.
      5) Verify neutral and ground conductors are properly landed.

   d. Site Testing:

      1) Ensure proper system start-up.
      2) Verify proper firmware control functions.
      3) Verify proper firmware bypass operation.
      4) Verify proper maintenance bypass switch operation.
      5) Verify system set points.
      6) Verify proper inverter operation and regulation circuits.
      7) Simulate utility power failure.
      8) Verify proper charger operation.
      9) Document, sign, and date all test results.

   e. On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation and alarm information.

M. Field Quality Control & Service Organization

1. Field Service Engineer Qualifications

a. The manufacturer must employ a 7 X 24 nationwide field service organization with rapid access to all regions of the nation. The responding service professionals must be factory-trained engineers with an accredited and proven competence to service three phase UPS systems.

2. Spare Parts

a. Field Engineers must have immediate access to recommended spare parts with additional parts storage located in regional depots. Additional spare parts shall be accessible on a 7 x 24 basis from the national depot and must be expedited on a next available flight basis or via direct courier (whichever mode is quickest).

3. Maintenance Training

a. The manufacturer shall make available to the customer various levels of training ranging from basic UPS operation to UPS maintenance.

4. Maintenance & Service Contracts

a. The manufacturer shall offer additional preventative maintenance and service contracts covering both the UPS system and the battery bank. Accredited professional service engineers, employed exclusively in the field of critical power systems service shall perform all maintenance and service. The manufacturer shall also offer extended warranty contracts.

2.21 SEALS

A. Water Tight Seals

1. Conduits entering from the exterior or below grade shall have water tight fittings on the outside and on the inside of the conduit.

a. Fittings on the outside of the conduit shall be O-Z Gedney type FSK or equal. Provide type WSK if penetration is within two feet of the high water table. Provide grounding attachment.
b. Fittings on the inside of the conduit shall be O-Z Gedney type CSBI or equal. Provide type CSBG if penetration is within two feet of the high water table. Provide a blank fitting to seal spare or empty conduits.
c. O-Z Gedney type CSM or equal fitting may be used when sealing within a sleeve or cored hole.

2. Submit on seals to be used.

B. Environmental Seals

1. Provide seals on raceways exposed to widely different temperatures, as in refrigerating or cold storage areas. Install seal to prevent circulation of air from warmer to colder sections through the raceway.

C. Hazardous Area Seals

1. Provide explosion proof seals as required by the Electric Code.

    a. Explosion-poof exhaust fans.

D. Smoke and Fire Stopping Seals

1. Provide a seal around raceways or cables penetrating full height walls (slab to slab), floors or ventilation or air handling ducts so that the spread of fire or products of combustion shall not be substantially increased.
2. Penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be firestopped using approved methods and NRTL listed products to maintain the fire resistance rating.
3. Fire stopping in sleeves or in areas that may require the addition or modification of installed cables or raceways shall be a soft, pliable, non-hardening fire stop putty. Putty shall be water resistant and intumescent. Provide for all sleeves and raceways.
4. Firestopping in locations not likely to require frequent modification shall be NRTL listed putty, caulk or mortar to meet the required fire resistant rating.
5. Box penetrations into a fire rated wall or shaft shall have a fire stopping pad installed on the back of the box.
6. Firestopping of cable trays or busways through walls shall be within a non-hardening putty or with seal bags.
7. Firestopping materials shall be NRTL listed to UL 1479 (ASTM E814). Installation methods shall conform to a UL firestopping system. Submit specifications and installation drawings for the type of material to be used. Firestopping materials shall be as manufactured by 3M, International Protective Coatings Corp., RayChem or approved equal.

2.22 LIGHTNING PROTECTION SYSTEM

A. General:

1. Provide all labor, material, equipment, and services required for the complete lightning protection system in accordance with NFPA 780, UL96A and applicable contract drawings for the Building. System shall receive UL Master Label. This section is responsible for providing a design for an approved “UL Master Label System” in accordance with the drawings and specifications.

B. The following items of work are specifically included in, but not necessarily limited to the work of this section without limiting the generality implied by the Specifications.

1. Air terminals.
2. Copper cable roof conductors.
3. Down conductor.
4. Ground grid installation.

C. Manufacturer shall provide seven complete sets of shop drawings for review, showing location of air terminals, conductors, installation procedures and details, and detailed manufacturer’s data sheets on all components, accessories, and miscellaneous equipment to be used in this installation.

D. Description of System:

1. The contractor shall provide a complete installation of equipment to comprise a system for protection against damage by lightning.
2. The system, including air terminals, conductors, and complementary parts, shall be installed so that completed work is unobtrusive and does not detract from the building appearance.
3. The work shall comply with all applicable federal, state, municipal laws, ordinances, and regulations.

E. Standards of Quality:

1. All materials shall be the product of a manufacturer regularly engaged in the production of lightning protection equipment.
2. All material shall be manufactured by Thompson Lightning Protection, Harger, East Coast Lightning Equipment, Heary Bros. or equal.

F. Service, Testing and Guarantee:

1. Installation of equipment shall be done under direct supervision of the equipment manufacturer's factory representative. A master labeled system is to be provided.
2. The completed lightning protection systems shall be fully tested in the presence of the Architect to demonstrate continuity of all conductors. A written test report shall be submitted.
3. The ground grid resistance shall be measured and a written statement submitted to the architect. Grid resistance shall be 5 ohms or less.

G. Products:

1. Air Terminals:

   a. Complete assembly consisting of chrome plated air terminal with attachment mechanisms.

2. Conductors:

   a. Copper conductors shall be 28 strands of #13 gauge, net weight 420 pounds per 1000 ft., minimum.

3. Ground Rods:

   a. Ground rods shall be copperweld, ¾ in. minimum diameter, 10 feet minimum length.

4. Connectors, Fitting, Fasteners and Hardware:

   a. Provide all connectors, fittings, fasteners, hardware, clamps, guards, lugs, etc., as required to connect, interconnect and install all parts of the system.
   b. All shall be fabricated from copper metal and be approved for use intended.
   c. All connections between dissimilar metals shall have connectors approved for this type of application.

H. Installation:

1. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.
2. All work installed within the building shall be concealed.
3. All work installed in accessible locations shall be properly guarded and protected.
4. All material shall be installed in a manner to prevent electrolyic action under the presence of moisture.
5. All roof, wall or other building penetrations shall be made in a manner to prevent the ingress of water or moisture. Roof penetrations shall be furnished and installed by Roofing Contractor.
6. PVC sleeves shall be provided where conductors pass through all floors.
7. Installation shall be accomplished in a manner to eliminate possibility of displacement and subsequent maintenance.
8. All connections shall be mechanically and electrically sound and all bonding surfaces shall be cleaned and brightened just prior to attachment.
9. All excavating, backfilling and tamping earthwork as required by General Trades Contractor.
10. Install down conductors concealed within wall.
11. Cables on flat roof areas may be run exposed. Adhesive type fasteners shall be spaced at 3 ft. – 0 in. maximum. Adhesive used shall be compatible with roofing materials. Coordinate with approved shop drawings.
12. Ground rods shall be driven to full depth in soil undisturbed by building excavation and are not to be driven into excavation backfill area.
13. Provide connection between grid and water service.
14. Provide grid resistance of 5 ohms maximum.
15. Top of ground rods shall be installed at least 2 ft. – 0 in. below finished grade.

I. Master Label:

1. Submit factory certified tests.
2. Submit guarantee for installation and range of lightning protection.

2.23 UNDERGROUND DUCTBANKS

A. General: Furnish and install the ductbanks as herein specified and as shown on 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. Installation of handholes/manholes
    d. Brick or concrete collars to bring handhole frames and covers up to grade. Installation of frames and collars which are to be furnished by the Electrical Subcontractor.
    e. Concrete Encasement

2. All other material, equipment, and labor required for the complete ductbank shall be furnished and installed by the Electrical Subcontractor under this Section, including the following:

a. Service raceways.
b. Grounding material.
c. Ductbank warning tape.
d. Furnishing pre-cast handholes/manholes.
e. Conduit spacers.

C. Materials:

1. Conduit: UL listed, schedule 40 PVC in accordance with NEMA standard TC-2. Schedule EB PVC is accetpable where encased in concrete.
See BASIC MATERIALS SECTION.

2. Conduit Supports (duct system): Shall be molded plastic with interlocking lugs and skeletonized structure, minimum separation 3 in.
3. Tags: Non-ferrous metal or fibre, 1/4 in. high letters.
4. Warning tape shall be yellow polyethylene 4 mil thick, 6 in. wide terratape, similar to REEF Industries, Houston, Texas and shall be installed above all ductbanks both high and low tension.
5. Installation of Underground nonmetallic raceways shall be in accordance with NEMA Standards Publication TCB-2-2017.

D. Duct System:

1. The duct system shall consist of Schedule 40 PVC conduit 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 handholes 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 is a minimum of 36 in. below finished grade unless otherwise indicated, and shall be laid to a minimum grade of 4 in. for each 100 feet of length. Duct system shall drain to manholes/handholes.
5. Changes in direction shall be made by long sweep bends, minimum radius 25 feet except that at the end of a run, within ten feet of termination. Manufactured ends may be used having a minimum radius of 36 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 in..
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 inches.
8. When the required number of conduits have been installed, securely tie the assembly together at distances not exceeding 7 ft. Tie shall consist of three turns of No. 18 iron wire. Separate ties required for low tension and high tension conduit runs.
9. Duct envelope shall be vibrated to eliminate voids.
10. Ductbanks shall not be covered until the conduit installation has been observed by the utility company and Architect.
11. Warning tape shall be installed during backfilling and shall be placed approximately 12 in. above the conduits.
12. After the installation is 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 in. long and the diameter approximately ¼ in. less than the conduit.

2.24 VARIABLE FREQUENCY DRIVES (VFD'S)

A. The variable frequency drives (VFD's) shall be solid state, with a Pulse Width Modulated (PWM) output waveform (VVI, six-step, and current source drives are not acceptable). The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device (SCR's, GTO's and Darlington transistors are not acceptable). The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.

B. Specifications at 480 volts:

1. Input VAC +/-10 percent (capable of operation to 550 VAC), 3 phase, 48-63Hz. Output 0 - Input Voltage, 3 phase, 0 to 500 Hz for drives up to 75 HP; 0 to 120 Hz for drives over 75 HP. Operation above 60 Hz. shall require programming changes to prevent inadvertent high speed operation. Environmental operating conditions: 0 to 40 C @ 3 kllz switching frequency, 0 to 3300 feet above sea level, less than 95 percent humidity, non-condensing. Units shall be UL, CUL and CA approved.

C. All VFD's shall have the following standard features:

1. All VFD's shall have the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control, for stepping through the displays and menus.
2. The VFD shall give the user the option of either (1) displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last reference revised, or (4) cause a Warning to be issued, if the input reference (4-20mA or 2-10V) is lost; as selected by the user. The VFD shall provide a programmable relay output for customer use to indicate the loss of reference condition.
3. The VFD's shall utilize plain English digital display (code numbers and letters are not acceptable). The digital display shall be a 40-character (2 line X 20 characters/line) LCD display. The LCD shall be backlit to provide easy viewing in any angle. All set-up parameters, indications, faults, warnings and other information must be displayed in words to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
4. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.
5. The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable. If the time between reset attempts is greater than zero, the time remaining until reset occurs shall count down on the display to warn an operator that a restart will occur.
6. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
7. The VFD shall be equipped with an automatic extended power loss ride-through circuit which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and not inertia. Removing power from the motor is not an acceptable method of increasing power loss ride-through.
8. The customer terminal strip shall be isolated from the line ground.

9. Prewired 3-position Hand-Off-Auto switch and speed potentiometer. When in "Hand", the VFD will be started, and the speed will be controlled from the speed potentiometer. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
10. The drive shall employ three current limit circuits to provide trip free operation.
11. The Slow Current Regulation limit circuit shall be adjustable to 125 percent (minimum) of the VFD's variable torque current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load. The Rapid Current Regulation limit shall be adjustable to 170 percent (minimum) of the VFD's variable torque current rating. The Current Switch-off limit shall be fixed at 255 percent (minimum, instantaneous) of the VFD's variable torque current rating. The overload rating of the drive shall be 110 percent of its variable torque current rating for 1 minute every 10 minutes, and 140 percent of its variable torque current rating for 2 seconds every 15 seconds, input line fuses standard in the drive enclosure. VFD shall have a DC Line Reactor to reduce the harmonics to the power line and to increase the fundamental power factor.
12. The VFD shall be optimized for a 4 kHz carrier frequency to reduce motor noise and provide high system efficiency. The carrier frequency shall be adjustable by the start-up engineer in ACH 501 units. The VFD shall have a manual speed potentiometer in addition to using the keypad as a means of controlling speed manually.

D. All VFD's to have the following adjustments:

1. Five programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.
2. PI Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control.
3. Two programmable analog inputs shall accept a current or voltage signal for speed reference, or for reference and actual (feedback) signals for PI controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 MA and 0-10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz.
4. Six programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock), drive is to resume normal operation.

E. The following operating information displays shall be standard on the VFD digital display. The display shall be in complete English words (alpha-numeric codes are not acceptable):

Output Frequency

Motor Speed (RPM, percent or Engineering units)

Motor Current

Calculated Motor Torque

Calculated Motor Power

DC Bus Voltage

Output Voltage

Heatsink Temperature

Analog Input Values

Keypad Reference Values

Elapsed Time Meter

kWh meter

F. Speed Command Input shall be via:

1. Keypad.
2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal. Input shall be isolated form ground, and programmable via the keypad for different uses.
3. Floating point input shall accept a three-wire input from a Dwyer photohelic (or equivalent type) instrument.

G. Accessories to be furnished and mounted by the drive manufacturer.

1. Customer Interlock Terminal Strip-provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external interlocks and start/stop contacts shall remain fully functional whether the drive is in hand, Auto or Bypass.
2. All wires to be individually numbered at both ends for ease of troubleshooting.
3. Door interlocked thermal magnetic circuit breaker which will disconnect all input power from the drive and all internally mounted options. The disconnect handle shall be thru-the-door type, and be padlockable in the "Off" position.
4. Manual transfer to line power via contactors. Include motor thermal overload and fuse or circuit breaker protection while in bypass operation. A three position selector switch to control the bypass contactor and the drive output contactor is to be mounted on the enclosure door. When in the "Normal" mode, the bypass contactor is open and the drive output contactor is closed. In the "Test" position both contactors are open, and in the "Bypass" position, the drive output contactor is open, and the bypass contactor is closed. The drive output contactor shall also open when a stop command is given, isolating the motor from the drive. Start/stop signals and safety interlocks will work in drive and bypass modes.
5. Pilot lights or LED’s shall be provided for indication of "Normal" operation, "Bypass" operation, and "External Fault". All pilot lights shall be push-to-test type.
6. Service contactor (drive input contactor) which provides the ability to service the drive (electrically isolate the drive while in bypass operation without having to remove power from the motor). The service contactor shall open when the drive is switched to bypass, and also be controlled by a switch which is mounted inside the drive enclosure so that its access is limited to service personnel only.
7. A class 20 bimetallic thermal motor overload relay shall be provided to protect the motor in bypass.

H. Compliance to IEEE - 519

1. The VFD manufacturer shall provide calculations specified to this installation showing that the Total harmonic Distortion for the VFD's, reflected into the electrical distribution system is limited to the level defined by IEEE - 519 (latest edition) for general systems. Harmonic analysis shall be included with VFD submittal for approval by the engineer.
2. The VFD manufacturer shall conduct on site harmonic measurements before and after startup of the VFD's. Results of the measurements, showing harmonic contribution of the VFD's, shall be provided to the engineer one month after start up.
3. Three phase A. C. input, 3 percent line reactors (externally mounted ahead of diode bridge) shall be provided as a minimum, with all VFD's. The line reactors are to provide attenuation of line side voltage transients, thus preventing overload trips or other unnecessary V.F.D. shutdown, and provide a reduction in harmonic distortion.
4. Line reactors shall have the following requirements:

    a. Two or three percent line impedance.
    b. 150 percent continuous current rating for one minute.
    c. Saturation rating no less than 2.5 times the continuous current rating.
    d. U.L. recognized.

I. General: Install variable frequency drives where indicated, in accordance with manufacturer's published installation instructions, complying with recognized practices to ensure that variable frequency drives comply with requirements and serve intended purposes.

J. Access: Provide access space around control panels for service as indicated, but in no case less than that recommended by manufacturer.

K. Support: Install drive control panels on walls where indicated on drawings. Provide necessary Unistrut and structural steel to provide adequate support as required by manufacturer.

L. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

M. Start-Up

1. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

N. Adjusting and Cleaning:

1. Alignment: Check compatibility of control panel to motor and where necessary, adjust frequency and provide necessary filters to assure noise free operation of motors. Verify response from control panel to motor to assure turn down ratio specified and that static pressure signals are being received and that drives are controlling as specified and within recommended tolerances by manufacturer. Provide start-up report prepared by manufacturers representative to assure operation is as specified.
2. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

O. Acceptable Manufacturers:

1. ABB
2. Allen – Bradley
3. Siemens
4. Square D
5. Or equal

2.25 FIRESTOP SYSTEMS

A. General: Provide firestopping at all fire-rated construction where penetrated by the Work of this Section.

B. Refer to Section 078400 – Firestopping, for all product requirements for maintaining integrity of fire-rated construction at penetrations.

2.26 UNDERFLOOR ELECTRIC RADIANT HEATING/SNOW MELT SYSTEM

A. GENERAL

1. SECTION INCLUDES

a. Underfloor electric floor warming cables.
b. Thermostats.
c. Underfloor radiant heating components, accessories and installation material for a complete operating system.

B. REFERENCES

1. National Electric Code (NEC).
2. Canadian Standards Association (CSA).
3. Underwriters Laboratories (UL).

C. SUBMITTALS

1. Submit under provisions of Section
2. Manufacturer's data sheets.
3. Installation Instructions.

D. PROJECT RECORD DOCUMENTS

1. Accurately record locations of heating cable and thermostat sensor.

E. QUALITYASSURANCE

1. Manufacturer Qualifications:

a. Minimum 50 years of experience in design, engineering, manufacture and support of specified system and components.

2. Product Requirements:

   a. All floor warming equipment furnished under this section shall be supplied by a single manufacturer.
   b. Installation shall safely control and maintain heat energy compatible with floor material.

      1) Minimum 11 watts per square foot.

F. DELIVERY, STORAGE, AND HANDLING

1. Store products in manufacturer's unopened packaging until ready for installation.

G. PROJECT CONDITIONS

1. Coordinate installation of heating cable with Electrical Contractor and Flooring Contractor.
2. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer. Do not install products under environmental conditions outside manufacturer's limits.

H. PRODUCTS

1. MANUFACTURERS

   a. System shall be manufactured by: OUELLET- 180 3rd Ave L'Islet Quebec, CA.
   b. Acceptable manufacturers contingent upon compliance with the specifications.

      1) Ouellet
      2) Raychem
      3) Thermon
      4) Delta-Therm
      5) Or Equal

2. HEATING / SNOW MELT CABLES (#OWC-M 3600 / #OWS)

   a. Connection leads shall be of sufficient length to reach junction boxes or power panel as shown on detailed drawings. Connection leads shall be of stranded wire. Only connection leads in conduit shall exit from heated zone.
   b. No combustible materials between conductor wire and ground sheath.
   c. Cross section of heated portion of cable not to exceed 0.4 inch (10 mm).
   d. Install cable in accordance with detailed layout drawings.
   e. Cable rating shall be: 208/1/60.

3. Floor Warming / Snow Melt Thermostats: (#OTH 3600 / # ETO-2)

   a. "All-in-one" programmable thermostat with large back-lit display.
   b. In-floor sensor measures exact floor temperature.
   c. Built-in GFCI and capacity to switch a 15 amp load without the use of a contactor.
   d. Thermostat rating shall be 208/1/60.

I. EXAMINATION

1. Installer to verify field measurements are as shown on Drawings.
2. Installer to verify that required power is available, in proper location, and ready for use.
3. Do not begin installation until substrates have been properly prepared.

J. PREPARATION

1. Clean surfaces prior to installation,.
2. Prepare surfaces as recommended by the manufacturer.

K. INSTALLATION

1. Complete installation shall conform to appropriate local codes.
2. Install cable heaters in accordance with detailed layout drawings and manufacturer's instructions.

L. FIELD QUALITY CONTROL

1. Test continuity of heating cable.
2. Test total resistance (TR) using an ohmmeter. The ohmmeter reading should be within 10% of the calculated Total Resistance.
3. Perform Insulation resistance (IR) or “Megger” test on each heating cable before, during and after installation. Insulation resistance should be greater than 10 megohms.
4. Measure voltage and current at each unit after installation is complete.
5. Submit written test report showing values measured on each test for each cable.

M. PROTECTION

1. Protect installed products until completion of project.
2. Repair or replace damaged products before Substantial Completion.

N. WARRANTY

1. 20 Years for manufacturing defects on the cable.
2. 3 Years for manufacturing defects on the controls

PART 3 -EXECUTION

3.1 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 Trades 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.

3.2 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 as indicated on the approved coordination drawings.

B. Specifications:

1. Specifications supplement drawings and provide specifics pertaining to methods and material to be used.

3.3 IDENTIFICATION

A. Equipment shall be marked for ease of identification as follows:

1. Provide screw-on nameplates on switchboards, panelboards, 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 ¼ in. high. Nameplates on panelboards shall have the following information.

   a. Line 1 - Panel designation in ½ in. high letters.
   b. Line 2 - Utilization voltage in 3/8 in. high letters.
   c. Line 3 - Distribution source "Fed from ¼ in. high letters.

2. Neatly typed directory cards listing circuit designations shall be fastened inside the cover of panelboards. Spare circuits shall be penciled.
3. Provide Signage on all rooms that contain Fire alarm control equipment within it. Where a Fire alarm control panel is located within a separate room provide permanent signage that reads “ FIRE ALARM CONTROL PANEL INSIDE” with minimum 7 in. high by 10 in. width with 2-inch high block letters a 0.5 in. letter stroke - white letters on a contrasting red background. The sign shall be permanently attached, at normal eye level to the door leading to the fire alarm control panel(s).

4. Color coding schedules. If there is more than a single system voltage, different voltages shall have separate color codes, as previously specified. A copy of the color code schedule shall be affixed to each 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 panelboard door.
5. 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 coverplate.
6. 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.

    a. Fire Alarm - red.
    b. Normal/Emergency - yellow.
    c. Security - blue.
    d. Sound - green.

7. Wiring device plates on devices connected to normal-emergency circuits shall be red in color.
8. All conductors in boxes larger than standard outlet boxes, in all wireways, and trench headers. shall be grouped logically and be identified.
9. Grounding conductors and neutrals shall be labeled in panels, and wireways. as to circuits associated with.
10. Emergency system wiring shall comply with 700.10(A).
11. Power and raceway identification:

    a. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
    b. Colors for Raceways Carrying Circuits at 600 V or Less:
    c. Black letters on an orange field.
    d. Legend: Indicate voltage and system or service type (Power, Lighting, Emergency, Control).
    e. Colors for Raceways Carrying Circuits at More Than 600 V:
    f. Black letters on an orange field.
    g. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters.
    h. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
    i. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway. Stop stripes at legends.
    j. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
    k. Write-On Tags: Polyester tag, with corrosion-resistant grommet and cable tie for attachment to conductor or cable. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

12. Armored metal clad cable identification:

    a. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
    b. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

13. Power and Control Cable identification:

    a. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
    b. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
    c. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
    d. Write-On Tags: Polyester tag, with corrosion-resistant grommet and cable tie for attachment to conductor or cable. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
    e. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

14. Conductor Identification materials:

    a. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
    b. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
    c. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
    d. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
    e. Write-On Tags: Polyester tag, with corrosion-resistant grommet and cable tie for attachment to conductor or cable. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

15. Underground warning tape:

    a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines but not less than 4 mils thick and 6 inches wide.
    b. Printing on tape shall be permanent and shall not be damaged by direct-burial service.
    c. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
    d. Color and Printing:

        1) Comply with ANSI Z535.1 through ANSI Z535.5.
        2) Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
        3) Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

16. Warning labels and signs:

    a. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
    b. Baked-Enamel Warning Signs:
    c. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. Nominal size, 7 by 10 inches.
    d. Metal-Backed, Butyrate Warning Signs:
    e. Weather-resistant signs, non-fading, preprinted, cellulose-acetate butyrate signs with galvanized-steel backing; and with colors, legend, and size required for application. Nominal size 10 by14 inches.
    f. Safety signs shall warn of potential electrical hazard and shall include, but are not limited to, the following legends:
    g. Multiple power source warning.
    h. Workspace clearance warning.
    i. Potential electric arc flash hazard.

17. Equipment identification labels:

    a. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
    b. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
    c. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

18. Cable ties:

    a. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
    b. Minimum Width: 3/16 inch.
    c. Color: Black except where used for color-coding.
    d. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
    e. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking. UL 94 Flame Rated.

19. Verify identity of each item before installing identification products. Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and required by code.
20. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
21. Apply identification devices to surfaces that require finish after completing finish work.
22. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
23. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

24. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
25. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
26. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
27. Outdoors: UV-stabilized nylon.
28. In Spaces Handling Environmental Air: Plenum rated.
29. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
30. Renovation Projects: For alterations and additions to existing facilities, use existing identification system. Where systems have not been standardized, use the identifying and marking system specified in this standard.
31. Distribution Equipment: Identify major components of the distribution system (such as circuit breakers, switches, transformers, switchboards, panelboards, motor control centers) with nameplates. Nameplates on disconnect switches and control stations shall identify the equipment served.
32. Identification Schedule:

    a. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for service, feeder, and branch circuits more than 30A and 120V to ground: Identify with self-adhesive vinyl label applied at 10-foot maximum intervals.
    b. Power-Circuit Conductor Identification, 600 V or Less: Identify conductors in the panels, pull and junction boxes, manholes, handholes.

        1) Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors for ungrounded service, feeder and branch-circuit conductors as specified in Division 26 Section “Low-Voltage Power Conductors”.
            a) Factory applied continuous color coding for conductors No.8 AWG and smaller.
            b) Field-applied, color coding conductor tape: For conductors No.6 AWG and larger. Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made.

        2) Lighting and Receptacle Outlet Boxes: Identify with the panel and circuit number.

    c. Power-Circuit Conductor Identification, above 600 V: For conductors in the vaults, pull and junction boxes, manholes and handholes, use write-on tags.
    d. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
    e. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
    f. Terminal Blocks: Attach numbered nameplates to terminal blocks which require identification numbers; use the designations shown on the wiring diagrams. Install nameplate at the top of vertically mounted terminal blocks and at the end of horizontally mounted terminal blocks. Indicate the individual terminal point designation shown on the wiring diagrams.
    g. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

h. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in the finished spaces.

i. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Apply warning, caution, and instruction signs where required by the referenced Electrical code, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install self-adhesive warning labels or baked-enamel warning signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed, butyrate warning signs for outdoor items.

j. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer, load shedding and other emergency operations.

k. Safety sign for the switchboards and panelboards: Provide a sign to warn qualified persons of potential electric arc flash hazard.

l. All electrical distribution equipment and mechanical/plumbing/fire protection equipment fed from the electrical distribution system shall contain in addition to the identification requirements listed in this section shall be labelled where they are fed from. For example Distribution panel 4DP1A is fed from MSB-1A, its label shall be "4DP1A fed from MSB-1A" submit full labeling scheme for review and approval.

m. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to the disconnect switches and protection equipment, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1) Labeling Instructions:
   a) Indoor Equipment: Self-adhesive, laminated acrylic or melamine label.
   b) Outdoor Equipment: Engraved, laminated acrylic.
   c) Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2) Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved laminated acrylic. Panelboard directories shall identify the load name and location (i.e. AHU-1, Room #, FCU-1, Room #).

3.4 PROTECTION AND CLEANUP

A. Protection:

1. Materials and equipment shall be suitably stored and protected from weather.
2. During progress of work, pipe and equipment openings shall be temporarily closed so as to prevent obstruction and damage.
3. 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.
2. At completion, equipment with factory finished surfaces shall be cleaned and damaged spots touched up with the same type paint applied at factory.
3. 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.

3.5 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.

3.6 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.

3.7 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.
2. 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.
3. Clock outlets - 84 inches.
4. Fire alarm pull stations - 48 inches.
5. Fire alarm audio visual signals - 80 inches or 6 inches below ceiling, whichever is lower.
6. Panelboards for lighting, power, telephone, and other auxiliary systems - 78 in. to top.
7. Equipment located in lobbies shall be located as detailed on architectural drawings or as directed by Architect.
8. All receptacles, light switches, fire alarm signals, and clocks sharing a common location shall be symmetrically arranged.
9. 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.

3.8 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 in. 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 ¼ in. 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:

    a. From outlet box by means of an interposed metal strap, where weight is less than five pounds.
    b. From outlet box by means of a hickey or other direct threaded connection, where weight is from five to fifty pounds.
    c. Directly from structural slab, deck or framing member, where weight exceeds fifty pounds.
    d. 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 non-standard pendant lengths where required to mount fixtures at elevations either called for on drawings or as shown in architectural elevations.

10. 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.
11. 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.
12. Provide channel sills or skids for leveling and support of all floor mounted electrical equipment.
13. Where permitted loading is exceeded by direct application of electrical equipment to a slab or deck, provide proper dunnage to distribute the weight in a safe manner.

14. 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.
2. Where weight applied to attachment points is 100 pounds or less, fasten to building elements of:

    a. Wood -- with wood screws.
    b. Concrete and solid masonry -- with bolts and expansion shields.
    c. Hollow construction -- with toggle bolts.
    d. Solid metal -- with machine screws in tapped holes or with welded studs.

3. Where weight applied to attachment points exceeds 100 pounds, fasten as follows:

    a. At field poured concrete slabs, provide inserts with 18 in.minimum length slip-through steel rods, set transverse to reinforcing steel.
    b. 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.

4. 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.
5. 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.
6. 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 traps.

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.
2. Raceways for normal emergency or emergency only wiring cannot contain other conductors.
3. 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.
4. Raceways run on trapeze hangers shall be secured to the trapeze.
5. 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.
6. 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.
7. 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.
8. All empty raceways shall be provided with a pull wire.
9. All raceway sleeves, stub-ups, or stub-outs, where not connected to a box or cabinet, shall be terminated with a bushing.

10. All raceway joints shall be made up tight and no running threads will be permitted.
11. Where raceways are cut, the inside edge shall be reamed smooth to prevent injury to conductors.
12. All vertical raceways passing through floor slabs shall be supported.
13. Raceways shall not be installed in concrete slabs above grade or below waterproofed slabs.
14. 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.
15. 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.
16. Raceways shall be installed in such a manner as to prevent collection of trapped condensates, and all runs shall be arranged to drain.
17. Raceways passing between refrigerated and non-refrigerated spaces and those penetrating enclosures with air movement shall be provided with seals.
18. 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.
19. Where two alternate wiring methods interconnect such as EMT to flexible metal conduit, an outlet box shall be provided.
20. All empty raceways entering building and all sleeves or core drilled openings through floors shall be sealed.
21. Each exterior raceway or assembly in a ductbank shall be provided with continuous warning tape installed 12 inches above raceway or ductbank.
22. 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.
23. Elbows and extensions of rigid non-metallic raceway systems which penetrate slabs shall be rigid or intermediate metal conduit.
24. Raceways used for transformer connections shall be flexible type and shall contain a grounding conductor.
25. Raceways entering building through foundation wall into a basement area shall be provided with wall entrance seals or with other acceptable waterproofing method.
26. Underground non-metallic raceways shall be fully surrounded by a selected backfill to prevent more than the desired deflection and, in power raceways is needed to provide room for heat dissipation and good compaction of backfill. Separation Between Direct-Buried, Non-encased Ducts: 3 inches minimum for like services, and 12 inches minimum between power and signal ducts, unless shown otherwise on the drawings. Raceways formation for non-encased ducts shall be built up layer by layer. After each layer is placed, the selected backfill shall be placed over it to the specified depth. This fill should be spread evenly and compacted to provide continuous support for the next tier of raceways. Any temporary spacers used should be removed from each layer of raceway as soon as backfill is completed in that layer. A maximum of 9 conduits shall be grouped in the same trench unless otherwise noted on the drawings.
27. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

28. Run conduit concealed in finished areas above suspended ceilings, in wall spaces. Exposed conduit runs in finished areas require Architect's approval. Properly group conduit runs. Install conduit parallel to walls, structure and ceilings, and support with proper hangers and clamps. Running conduits at the bottom of structural members in exposed conditions is not allowed. Check door swings before installing back boxes for switches and receptacles.
29. Where conduit passes through a building expansion joint, use weatherproof, telescopic type expansion fittings which permit at least 4 inches of movement.
30. Form bends in conduit by means of a conduit bending machine or by an approved hickey. To fasten conduit to outlet boxes, cabinets, use locknuts and insulated throat bushings of compatible material.
31. Cut conduit ends square, thread conduit, and ream to remove burrs and sharp edges. Field threads shall be of the same type and have the same effective length as factory cut threads. Turns, wherever required in exposed conduit runs, shall be made by the use of factory-made bends, or field-made bends that meet the requirements of this Section and Electric Code. In the event of a multiplicity of conduits making the same turn, a steel junction box with a removable steel cover may be used. Offsets and bends for changes in elevation of exposed conduit runs shall be made at walls or beams and not in open spaces between walls or beams. Rout conduits required to avoid interfere with the operation or maintenance of equipment.
32. Plug or cap conduit ends as soon as conduit is installed, to prevent entrance of moisture or other debris during construction. Do not pull wire into any conduit until the conduit system is complete.
33. Drawings, in relation to the routing of conduits, are diagrammatic. Except where additional conduits may be required to avoid derating of branch circuits, elsewhere within this Section, the number and size of conduits and wire shall be furnished and installed as indicated by the drawings. Coordinate routing of conduits in the field with the building structure. Run conduit in straight lines parallel and perpendicular to walls, beams, and columns and with right angle bends and threaded conduit fittings. Maintain 12 inches clearance between conduit and surface with temperatures exceeding 104 degrees F.
34. Conduits passing through floors, walls and beams shall be of such size, number, and in such locations so as not to impair the strength of the construction.
35. Rout raceways in ceiling spaces in an orderly and organized manner, and to eliminate or minimize the number of junction boxes required. Support and secure conduits by means of rods, clamps and other conduit support devices approved by the Architect. Do not use wire to support conduits.
36. Where rigid metal conduit is threaded in the field, use a standard conduit cutting die providing 3/4 inch taper per foot.
37. Conduit and EMT runs shall be mechanically and electrically continuous from service entrance to outlets. Secure conduit to cabinet, junction box, pull box or outlet box with locknut outside and bushing inside, or with liquid-tight, threaded, self-locking, cold-weld wedge adapter. Locknuts and bushings or self-locking adapters will not be required where conduits are screwed into tapped connections. Before installing conductions, protect vertical conduit runs that terminate in bottoms of wall boxes or cabinets from entrance of foreign material.
38. Size rigid steel conduit, EMT and flexible metallic conduit required by the referenced Electrical Code, except as otherwise specified or shown on the drawings. Check raceway sizes to determine that equipment grounding conductor fits in same raceway with phase and neutral conductors to meet Massachusetts Electrical Code percentage of fill requirements.
39. Where conduit is secured rigidly on opposite sides of building expansion joints, and where runs of exposed conduit are long and subject to stress, provide expansion fittings capable of safely deflecting and expanding to twice the distance of structural movement. Provide separate external copper bonding jumper secured with grounding straps on each end of fitting.

40. Install a pull or junction box every 100 feet of straight conduit run, and wherever there is an equivalent of four 90 degree elbows or a total of 360 degree bend. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
41. Install sealing fittings at following points, and elsewhere as shown:

    a. Where conduits enter or leave hazardous areas equipped with explosion proof lighting fixtures, switches, receptacles, and other electrical devices.
    b. Where conduits pass from warm to cold locations.

42. Pull cords: In each empty raceway, provide nylon fishing line having tensile strength not less than 200 lbs, or provide No. 14 AWG steel wire. Label each end of each line or wire with a securely attached tag which indicates the location of the other end.
43. Liquid-tight type flexible conduits installed in the air-handling plenum space shall be with a plenum- rated outer jacket.
44. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

E. General Outlet Box Installation:

1. Boxes shall be set flush with finish surface and provided with proper type extension rings or plaster covers. Thru the wall boxes are not permitted. Check device or fixture to be mounted to box to ensure box orientation is proper.
2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operation.
3. Plug unused openings on all remove knockouts.
4. 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.
5. 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.
6. 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, and structural members.
7. In case of conflict with standard mounting heights and device alignment, consult Architect prior to roughing.
8. Check all door swings on architectural drawings to ensure lighting switches are installed on strike side of door.
9. 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.
10. Obtain dimensioned plan from Architect for floor outlets.
11. 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.
2. All conductors shall be wired so that grounded conductor is unbroken; switches in all cases being connected in ungrounded conductor.
3. Connections throughout the entire job shall be made with solderless type devices of approved design satisfactory to Inspector of Wires.

4. All taps and splices shall be insulated equal to that of conductor insulation.
5. All conductors of each feeder in pull boxes and wireways. shall be grouped, tied together, supported, and identified.
6. All conductors in panelboards and other wiring enclosures shall be neatly formed and grouped.
7. All conductors of emergency only and/or normal/emergency shall be run in separate raceway systems to final outlet box.
8. Provide support for conductors in vertical raceways in accordance with Article 300-19.
9. Strip insulation from conductors with approved tools and only of sufficient length for proper termination. Cutting of conductor stranding is unacceptable.
10. Taps from paralleled conductors shall be of a type which tap each conductor, such as ILSCO "PTA" series.
11. 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 ty-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 screwhead. 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.

2. Stranded conductors will not be allowed for fire alarm work.

I. Accessibility:

1. Electrical equipment requiring service or manual operation shall be accessible.
2. 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: All equipment connections to rotating equipment or equipment capable of vibration shall be made up by flexible raceways.

K. Wiring Device Gaskets: Provide wiring device gaskets at coverplates where device is mounted in wall separating conditioned and non-conditioned spaces.

3.9 FEEDER CIRCUITS

A. Provide feeders as called for on the drawings.

B. Feeders shall be defined as any circuit originating from the distribution panels.

C. All feeder conductors shall be continuous from origin to panel or equipment termination without splicing.

D. All feeders shall be conductors pulled into raceways. Cable systems are not allowed for feeders unless specifically indicated.

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. 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. General: Install firestop systems at all new and existing fire-rated construction where penetrated by the Work of this Section.

B. Refer to Section 078410 – Penetration Firestopping, for all installation requirements for maintaining integrity of fire-rated construction at penetrations.

3.12 CUTTING AND PATCHING

A. Openings through new wall surfaces will be provided by General Conditions if Electrical contractor gives suitable notice as erection of surface proceeds. If suitable notice is not given, Electrical contractor 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 ELEVATOR COORDINATION

A. Elevator Electrical Work:

1. Several items pertaining to elevator electrical system shall be provided by Electrical Subcontractor as follows:

a. Power source to elevator machine room including fused disconnect switch and wiring between disconnect switch and controller for each elevator.
b. Power source to elevator machine room including fused disconnect switch (120 volt) for elevator signal system and cab light for each cab.
c. Light, switch, and GFCI receptacle in each pit.
d. Light, switch, and GFCI receptacle in machine room.
e. Junction box in machine room with five control modules from fire alarm system for elevator recall to prevent cab opening on a fire floor.
f. Junction box in machine room for cab telephone with one 1 in. conduit with (2) CAT 6 telephone cables to main telephone demarcation backboard.
g. Power to automatic damper in hoistway penthouse louver.
h. Power wiring to elevator sump pump.

3.14 MECHANICAL SYSTEM COORDINATION

A. The Mechanical System contractor will be providing various items of mechanical services equipment and control apparatus. In general, Electrical contractor shall connect up power wiring to this equipment.

B. The Mechanical and Electrical contractor 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 contractor's licensed electricians, it will then be Mechanical contractor's responsibility to engage and pay for services of such licensed electricians.

D. Power wiring to be provided by Electrical contractor is the line voltage power supply wiring. Control wiring is responsibility of Mechanical System contractor unless specifically indicated on electrical drawings, or in this Division of the specifications. Temperature Control contractor shall refer to electrical drawings for location of all magnetic starters.

E. 120-volt control wiring source to temperature control panel is the responsibility of Electrical contractor.

3.15 DISTRIBUTION EQUIPMENT TESTING

A. All panelboards, individual motor starters, main distribution panel, motor controls, feeder conductors, and emergency systems shall be tested in accordance with the following. In general, all tests shall be done in accordance with the 2017 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 Panel:

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.

2. Physical Inspection:

a. Torque all bus hardware to proper tension.
b. Circuit breaker interlocks all work properly.
c. All doors and hinged panels open and close properly.
d. Relay blocking removed from all control and protective relays.
e. All circuit breakers operate, close and trip mechanically.
f. Torque all feeder conductors to terminal manufacturers' recommendations.

3. Electrical Testing:

a. Breakers operated electrically trip and close from local and remote positions.
b. All circuit breakers calibrated to manufacturer's respective time current curves as specified.

1) Long time pick-up amps.
2) Long time delay tripping at 300 percent of current setting.
3) Resets okay at 80 percent of pick-up value.
4) Short time pick-up current.
5) Short time delay trip time at 105 percent of setting.
6) Instantaneous minimum pick-up current.

c. All protective relays calibrated to manufacturer's characteristic time curves for pick-up, drop-out, instantaneous and time delay.
d. All instruments calibrated for accuracy.
e. Protective relay schemes to be electrically tested by primary injection of current through current transformers and the tripping of associated circuit breakers.
f. 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. Magnetic Starters:

1. 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.

2. Electrical Testing:

a. Electrical operation of control relays, timing relay, and contactor coils.
b. Insulation resistance test on all current carrying bus to ground and between phases.
c. Calibration check of overload heater to ascertain tripping point and time delay at 300 percent of heater rating.

F. Conductors:

1. All secondary service conductors and all feeder conductors from switchboards and distribution panels shall be tested.
2. 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.

3. Electrical Tests:

a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductor.
b. 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:

1) Perform a dielectric absorption test on generator winding with respect to ground. Determine polarization index.
2) Perform phase rotation test to determine compatibility with load requirements.
3) Test protective relay devices in accordance with applicable sections of these specifications.
4) Perform dc over potential test between winding and ground.

2. Automatic Transfer Switches:

a. 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.

b. 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.
   a) Voltage and frequency sensing relays.
   b) All time delay relays.
   c) Engine start and shutdown relay.

4) Perform automatic transfer by tests.
   a) Simulating loss of normal power.
   b) Return to normal power.
   c) Simulating loss of emergency power on return to normal.
   d) Simulate all forms of single phase conditions.

5) Monitor and verify correct operation and timing.
   a) Normal voltage sensing relays.
   b) Engine start sequence.
   c) Time delay upon transfer.
   d) Alternate voltage sensing relays.
   e) Automatic transfer operation.
   f) Interlocks and limit switch function.
   g) Timing delay and retransfer upon normal power restoration.
   h) Engine cool down and shutdown feature.

3.16 FAULT CURRENT, ARC FLASH AND COORDINATION STUDY

A. Trade Contract:

1. Work of this Section is part of the Electrical trade contract. Refer to Section 260010 for additional information about this work.

B. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

C. Scope:

1. The Electrical SubContractor shall furnish short-circuit and protective device coordination studies as prepared by the manufacturer of the switchgear provided for the project. Mechanical equipment shall be included in the study in accordance with NEC 440.4(B) and require documentation per 440.10(B).
2. The Electrical SubContractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002, the IEEE Guide for Performing Arc-Flash Calculations.
3. The scope of the studies shall include new distribution equipment supplied by switchgear manufacturer furnishing the electrical distribution equipment for this project.

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

2. American National Standards Institute (ANSI):

   a. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
   b. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
   c. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
   d. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single- Pole Air Switches, Fuse Disconnecting Switches and Accessories.

3. The National Fire Protection Association (NFPA)

   a. NFPA 70 -National Electrical Code, latest edition
   b. NFPA 70E – Standard for Electrical Safety in the Workplace

E. Submittals For Review/Approval:

1. The 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 study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

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. A minimum of five (5) bound copies of the complete final report shall be submitted. For large system studies,
2. requiring more than five copies of the report will be provided without the section containing the computer printout of the short- circuit input and output data. Electronic PDF copies of the report shall be provided upon request.
3. The report shall include the following sections:

    a. Executive Summary including Introduction, Scope of Work and Results/Recommendations.
    b. Short-Circuit Methodology Analysis Results and Recommendations
    c. Short-Circuit Device Evaluation Table
    d. Protective Device Coordination Methodology Analysis Results and Recommendations
    e. Protective Device Settings Table
    f. Time-Current Coordination Graphs and Recommendations
    g. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
    h. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
    i. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

G. Qualifications:

1. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
2. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer.
3. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.

H. Computer Analysis Software:

1. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program.

I. Studies:

1. The Electrical SubContractor 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. This study shall also include short-circuit and protective device coordination studies.

J. Data:

1. Electrical SubContractor shall furnish all data as required for 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 Electrical SubContractor 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.
2. Source combination may include present and future motors and generators.
3. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or General Contractor.
4. If applicable, include fault contribution of existing motors in the study. The Electrical SubContractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

K. Short-Circuit Analysis:

1. Transformer design impedances shall be used when test impedances are not available.
2. Provide the following:

    a. Calculation methods and assumptions
    b. Selected base per unit quantities
    c. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
    d. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
    e. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
    f. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

3. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

4. Protective Device Evaluation:

    a. Evaluate equipment and protective devices and compare to short circuit ratings
    b. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short- circuit stresses
    c. Switchgear Manufacturer shall notify Owner in writing, of any circuit protective devices improperly rated for the calculated available fault current.

L. Protective Device Time-Current Coordination Analysis:

1. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
2. Include on each TCC graph, a complete title with descriptive device names.
3. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
4. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
5. Plot the following characteristics on the TCC graphs, where applicable:

    a. Electric utility's overcurrent protective device
    b. Medium voltage equipment overcurrent relays
    c. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
    d. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
    e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
    f. Medium voltage conductor damage curves
    g. Ground fault protective devices, as applicable
    h. Pertinent motor starting characteristics and motor damage points, where applicable
    i. Pertinent generator short-circuit decrement curve and generator damage point
    j. The largest feeder circuit breaker in each motor control center and applicable panelboard.

6. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

    a. Provide the following:

        1) A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
        2) A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
        3) Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
        4) The study shall include a separate, tabular printout containing the recommended settings of all
        5) adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram

6) A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
7) Switchgear Manufacturer shall notify Owner in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.

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-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04).
2. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
3. Circuits 240V or less fed by single transformer rated less than 125 kVA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E.
4. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.
5. 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
6. 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 in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.
   The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
7. 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 should be decremented as follows:

   a. Fault contribution from induction motors should not be considered beyond 5 cycles. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

8. 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.

9. Mis-coordination 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.
10. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used 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.
11. Provide the following:

    a. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
    b. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
    c. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

N. Field Adjustment:

1. Electrical SubContractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
2. Electrical SubContractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
3. Switchgear manufacturer shall notify the design engineer in writing of any required major equipment modifications.

O. Arc Flash Labels:

1. Electrical SubContractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.
2. The labels shall be designed according to the following standards:

    a. UL969 – Standard for Marking and Labeling Systems
    b. ANSI Z535.4 – Product Safety Signs and Labels
    c. NFPA 70 (National Electric Code) – Article 110.16

3. The label shall include the following information:

    a. System Voltage
    b. Flash protection boundary
    c. Personal Protective Equipment category
    d. Arc Flash Incident energy value (cal/cm²)
    e. Limited, restricted, and prohibited Approach Boundaries
    f. Study report number and issue date

4. Labels shall be printed by a thermal transfer type printer, with no field markings.
5. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:

    a. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with

multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.

b. Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.

P. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

3.17 WASTE MANAGEMENT

A. Separate and recycle materials and material packaging in accordance with Waste Management Plan and to the maximum extent economically feasible and place in designated areas for recycling.

B. Set aside and protect materials suitable for reuse and/or remanufacturing.

C. Separate and fold up metal banding; flatten and place along with other metal scrap for recycling in designated area.

D. Coordinate with Section 017400 – CONSTRUCTION WASTE MANAGEMENT.

3.18 TRAINING

S. All training shall be scheduled with the user. Training shall be videotaped and a Thumb Drive delivered to the Owner. Refer to each specific system for amount of training required.

3.19 SPARE PARTS/ATTIC STOCK:

T. REQUIREMENTS:

1. Provide attic stock of the following quantities and parts for each piece of equipment as follows:

Equipment/Unit	Parts Description	Quantity
LED Lights	LED Drivers	2 of each type
	Single faced exit signs	3
	Double faced exit signs	3
Fire Alarm	Smoke detectors of each type (Duct, ceiling, fire detectors)	3
	Detector	3
	Pull stations	3
	Spare printer ribbon	1
	Extra set of keys and tools for access to locked and tamperproof components	3

3.20 STORAGE AND INSTALLATION OF EQUIPMENT

A. The electrical subcontractor shall store and install electrical equipment and wiring listed for dry locations only after the building is watertight.

END OF SECTION

SECTION 270000

COMMISSIONING
(Filed Sub-Sub Bid Required)

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SECTION 270000

COMMUNICATIONS
(Filed Sub-Sub Bid Required)

PART 1 - GENERAL

1.1 FILING OF FILED SUB-SUB BIDS

A. Filed Sub-Sub-Bid Requiring a Paragraph “E” Listing on the FORM FOR SUB-BID required per M.G.L. Chapter 149 Section 44A to 44L, as amended to date. The Electrical Subcontractor will be responsible for all related building preparation and coordination, see specification for additional Paragraph “E” Listing requirements of the Listed Systems Contractor, and coordination of responsibilities.

B. Section 27 00 00 COMMUNICATIONS shall be a Filed Sub-Sub Bid of Section 26 00 10, requiring a Paragraph “E” Listing on the FORM FOR SUB-BID.

C. Work to be done in this SECTION is included in the Contract Documents as listed in the List of Drawings.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 01 Section “Summary.”

1.3 GENERAL REQUIREMENTS

A. The Conditions of the Contract and General Requirements of the Project Manual apply to this Subcontractor, material suppliers, and all other persons furnishing labor and materials under this Section. The General Conditions, and applicable parts of Division 01 are included as part of this Section.

B. Examine all Project Specifications and Drawings for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. The following definitions apply to the Drawings and Specifications:

1. Furnish: The term "furnish" is used to mean "supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations".
2. Install: The term "install" is used to describe operations at the Project Site including actual "unloading, unpacking, assembly, erection, piecing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".
3. Provide: The term "provide" is used to mean "furnish and install, complete and ready for the intended use".
4. Installer: An "installer" is the Contractor or an entity engaged by the Contractor, either as an employee, Subcontractor, or Sub-Subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

E. When open-flame or spark producing tools such as blow torches, welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four (24) hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain constant non-working fire watch where work is being performed until it is completed.

1.4 QUALITY ASSURANCE

A. Sustainable Goals: The Architect has designed the project to meet the Owner's sustainable goals. Products and systems have been specified which meet certain third-party evaluations or have particular VOC and source requirements. Evaluation of products proposed for substitution will be evaluated based on the Owner's sustainable goals and other criteria included in Division 01. The Contractor is encouraged to use sustainable construction practices, means and methods. Unless specifically stated in a specification section, no sustainable design documentation is required of the Contractor.

1.5 COOPERATION AND COORDINATION WITH OTHER TRADES

A. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed and not interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as directed.

B. This Section shall be furnish/installed as follows by a single firm/company that is a qualified systems contractor. The Electrical Subcontractor shall be responsible for properly preparing the project for installation by systems contractor, as specified.

1. Electrical Subcontractor responsibilities shall include: The Electrical Subcontractor shall be responsible for furnishing and installing all related building preparation including, but not limited to: outlet boxes with plaster rings, floor boxes, poke through devices, pathways, power, cableways, cable tray, cable protection, wiremold, surface raceways, cable supports, J hooks, conduits with bushings, conduit stubs with bushings, sleeves with bushings (all conduits, stubs, sleeves, etc. shall be brought to an accessible ceiling or accessible area below floor), pull strings, bonding, grounding, core drilling, cutting, patching, environmental seals, seismic supports, supplementary steel and channels, etc., for a completely operational system, as specified. The Electrical Subcontractor shall also accept delivery and properly store & secure all equipment and materials required by the systems contractor. The Electrical Subcontractor shall install all specialized backboxes and any exterior antennas furnished by Systems Contractor.

   a. The Electrical Subcontractor shall provide cable tray over each rack and cabinet as required to facilitate a neat and orderly installation of cables and to secure the top of the racks to the structure. Cables shall drop straight down to equipment racks. Cable trays shall be secured at both ends to the structure and connected together as required for a complete contiguous installation. Utilize proper supports to support the cable tray to the building structure as well as the equipment rack and cabinet. Submit mounting supports for approval before installation.
   b. Communication cables installed outside DCOA areas that serve the DCOA shall be installed in accordance with NEC 708.14.
   c. This entire Section: The Electrical Subcontractor shall read this section in its entirety and shall provide all requirements of the Electrical Subcontractor as detailed in this Section.

2. Systems Contractor responsibilities for this section shall be: Systems contractor shall be responsible for providing, installing, programming, troubleshooting, training and warranty service of all cabling, terminal equipment, headend equipment specified in this section for a completely operational system.

    a. Keep fully informed as to the shape, size and position of all openings required for all apparatus and give information in advance to build openings into the work. The electrical subcontractor shall furnish and set in place all sleeves, pockets, supports and incidentals.
    b. All distribution systems which require pitch or slope such as plumbing drains, steam and condensate piping shall have the right of way over those which do not. Confer with other trades as to the location of pipes, ducts, lights and apparatus and install work to avoid interferences.
    c. Coordinate exact locations and roughing in dimensions of all work before installation and make all final connections as required. Any changes required to avoid interferences or to provide adequate clearances for Code and maintenance requirements shall be made at no additional costs.
    d. Structural elements of the project shall not be relocated, altered or changed to accommodate the work without written authorization from the Architect.
    e. Work that is installed before coordination with other trades or that causes interference with the work of other trades shall be changed to correct condition.
    f. Obtain a complete set of Project Drawings and Specifications for coordination and to determine the full scope of work.
    g. Attend project coordination meetings to coordinate work of this Section, work of other trades and project and phasing requirements.

1.6 SUBMITTALS

A. Product Data for all materials specified and shown on drawings to be installed.

B. Equipment List: Provide a detailed Equipment List showing quantities by manufacturer and model number of all major items of equipment and installation material to be used in the system as specified herein.

C. Submit supporting hardware for this system as part of the work for approval prior to installation.

D. Product Data: Include complete sets of indexed cut sheets, in quantity as dictated by the project, of all major pieces of equipment and materials being supplied. Arrange these sheets in the order the equipment appears in the Specification. Clearly highlight information showing compliance with this and/or all applicable Specifications. In the event that the manufacturer or representatives' cut sheet contains more than one item, clearly indicate which items of the cut sheet are intended for installation.

E. Shop Drawings: Submit a set of complete Shop Drawings, by system, showing equipment to be installed. Include system configuration block diagrams of all equipment, indicating equipment type and model numbers. Show each and every component, system and subsystem, as well as all proposed connections between system components, and proposed layouts of equipment racks for the entire system.

    1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
    2. Cabling administration drawings and printouts.
    3. Wiring diagrams to show typical wiring schematics including the cross-connects.

4. Cross-connects. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
6. Cable tray layout showing cable tray route to scale with relationship between the tray and adjacent structural, electrical and mechanical elements.

F. Quality Assurance Submittals:

1. Provide manufacturer's certification that Installer is qualified to install systems specified. Include a written statement signed by the Installer attesting that they have been in business for at least five years in the installation and servicing of systems specified. Include the names of at least five clients for whom similar Work as specified has been performed in the past three years; list the individual responsible for the day-to-day operation of the system along with their current telephone number and address.
2. Provide names, qualifications, and certifications of installation personnel including Communication Systems Installer's site Supervisor/Foreman who shall be in charge of, and responsible for, all activities at the job site for the duration of the Project. The job Supervisor/Foreman shall not be changed during the project without notification and approval from the Owner.
3. Complete warranty information including sample Registration Certificate.
4. Technical Diagrams and Drawings:

    a. Simplified single line block diagrams showing the interconnection of all equipment and functional relationships. Show all equipment, patch panels, cables and jacks, whether connected or not. The intent of these diagrams is to provide sufficient clear and complete information that a technician of average skill may efficiently troubleshoot and service the system, even if unfamiliar with the installation.
    b. Provide "As Built" architectural quality plan Drawings at 1/8 in. = 1 ft.-0 in. scale. Provide an electronic copy of the "As Built" drawings on CD(s).
    c. All technical diagrams and drawings shall be mounted on the wall behind a clear plastic cover for protection. There shall be one set of the above drawings and diagrams provided for the MDF Room.

1.7 TELEPHONE/DATA SYSTEM

A. General:

1. All telecommunication and data system interconnecting wiring, terminal blocks, connections, terminations, shall be furnished and installed by a licensed and certified installer.
2. The Electrical Subcontractor (E.C.) shall furnish and install all raceways, and outlet boxes as indicated on the drawings, including pull wires for all empty raceways and all access panels. General contractor will furnish and install all backboards (3/4 in. thick by 78 in. high) which shall be mounted at the MDF room.
3. General Requirements:

    a. Applicable Standards:

        1) Materials and equipment shall be installed in accordance with the most current versions of the National Electrical Code, local codes, safety codes, ANSI, ASTM, EIA, TIA, BISCI, IEEE, UL, NFPA.

a) The following industry standards are the basis for the structured cabling system described in this document.

ANSI/TIA/EIA	
TIA/EIA-568-B	Commercial Building Telecommunications Cabling Standard
TIA/EIA-568-B.1	General Requirements
TIA/EIA-568-B.2	Balanced Twisted Pair Cabling Components Standard
TIA/EIA-568-B.3	Optical Fiber Cabling Components Standard
TIA/EIA - 942	Telecommunications Infrastructure for Data Centers
TIA/EIA-569-A	Commercial Building Standard for Telecommunications Pathway and Spaces
TIA/EIA-606-A	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
J-STD-607-A	Commercial Building Grounding/Bonding Requirements NFPA
NFPA 70	National Electric Code (NEC) ISO/IEC
ISO 11801	Generic Cabling for Customer Premises
EIA/TIA-TSB 67.	Telecommunications Systems Bulletin, Additional Transmission Specifications for Unshielded Twisted-Pair Cabling Systems"
EIA/TIA-455-61.	"FOTP-61, Measurement of Fiber or Cable Attenuation Using An OTDR".
IEEE 802.3	"Carrier Sense Multiple Access With Collision Detection".
ATM	Forum Standard for 155 Mb/s ATM over Category 6 (AF-PHY-0015.000, 9/94)
BISCI:	Telecommunications Distribution Methods and LAN Design Manual
IEEE-802:	Standards for Local Area Networking
UL	Performance Levels Certification Program
ANSI-IEEE-C2:	National Electrical Safety Code (NESC)
ANSI/NFPA-101:	Life Safety Code
Massachusetts Electric Code CMR527	

b. Exposed wiring is not acceptable in any occupied space.
c. Contractor is responsible for strict adherence to Massachusetts electrical codes, and all other applicable codes.
d. The contractor is responsible for obtaining municipal permits and inspections as mandated by law.
e. All exposed cabling shall be run in raceway or conduit.
f. All penetrations in station raceway shall have rubber or equivalent grommets to prevent cable cuts on rough edges.
g. Raceway shall be of sufficient size to accommodate all wiring. Fill density not to exceed 40 percent, unless otherwise noted. It is the responsibility of the bidder to determine the size needed based upon the floor plans provided. A minimum size of 1 in. conduit shall be adhered to, U.N.O or approval by the engineer.
h. All raceways shall be attached to the building structure using screws and anchors.
i. The I.T. subcontractor is responsible for all aspects of MDF construction. Refer to drawings for configuration of each MDF.

j. All cabling at the MDF shall be neatly bundled and dressed to the termination blocks. All appropriate cable management materials (slotted duct, D rings, etc.) should be utilized for this purpose.
k. All labeling of cables shall be 6 in. back from the termination with machine generated labels, hand written labels are not permitted.
l. All cable pulls in conduit, raceway, innerduct, etc. shall have pull string left in place for future use.
m. Color code identification of cables must be maintained throughout all splices.
n. All station cabling shall be clearly and legibly labeled at both the faceplate end and the MDF termination blocks. In addition to labeling both the inside of the faceplates and MDF termination blocks, the cable jacket shall be labeled six inches back from the terminations on both ends. Labeling shall be machine generated.
o. Labeling of the outside of the jack with identification numbers shall be made using a Panduit LS8 handheld label machine or equal. Samples shall be provided to Engineer for approval prior to installation; the labeling scheme shall be submitted for review and approval, coordinate with the IT Department prior to submitting.
p. In order to qualify for installation of the data communications system, Contractor must possess the required license classification, a performance history, experience in the installation and termination of optical fiber cable systems, and proof of time in business. Contractor must be trained and certified for the communications cable and hardware which it installs, and must furnish proof of certification.
q. License Classification: Contractor must possess a valid state Contractor's License.

B. Unless otherwise indicated, the following work is not included as part of the systems integrator's responsibilities in this SECTION, except for coordination, and is to be performed by others as indicated:

1. Raceway shall be provided by the electrical contractor.
2. Empty conduits to accessible point above ceiling or below floor shall be provided by the electrical contractor.
3. Floor boxes and poke through devices shall be provided by the electrical contractor.
4. Standard device boxes with plaster rings for data and Integrated Instructional Technology Network System shall be provided by the electrical contractor.
5. Speaker/paging system backboxes shall be installed by the electrical contractor and provided by this systems integrator.
6. Structural blocking to support wall and ceiling mounted televisions/monitors shall be provided by the General Contractor.
7. Interface with public utilities telephone service shall be arranged by the owner, and coordinated with this systems integrator.
8. Telephone equipment and handsets will be provided under a separate contract.

1.8 DEFINITIONS

A. Main Cross Connect (MC): The MC is the location, within a building or complex of buildings, where the entire telecommunications system originates. It may include: the physical location, enclosure, wire and cable management hardware, termination hardware, distribution hardware, and patching and equipment racks.

B. Horizontal Cross Connect (HC): The HC is the location in a building where a transition between the backbone or vertical riser system and the horizontal distribution system occurs.

C. Designated Critical Operations Areas (DCOA) areas within a facility or site designated as requiring critical operations power.

D. Telecommunications main ground bar (TMGB)

1.9 SYSTEM DESCRIPTION

A. The data communications system shall consist of four components, active switch equipment, an optical fiber backbone, a copper twisted-pair backbone, and twisted pair copper work station cabling.

B. The audio-visual systems shall consist of wiring, jacks, amplification equipment, control equipment, and head end video equipment.

C. The work under this Section includes providing of all material, labor, equipment and supplies and the performance of all operations to provide a complete working Integrated Instructional Technology Network System as required by the Drawings and details and as specified herein. Where the Drawings, Specifications, Codes, Regulations, Laws, or the requirements of the local Authority conflict, provide the higher quality and higher quantity indicated or required and follow the strictest requirement. In general, the work includes, but is not limited to, the following:

1. Cabling for Sound per manufacturers requirements.
2. Equipment Racks and Cabinets.
3. Relay Brackets.
4. Terminations.
5. Protection of all work.
6. Record Drawings and Documentation.
7. Staging.
8. Telephone and data cabling.
9. Data network racks and patch panels
10. Operation and Maintenance Instructions and Manuals for the Section's work.
11. Nameplates, Labels and Tags.
12. Testing and certification.
13. Coordination with manufacturers, other trades and Owner.
14. CATV wiring, amps and splitters.
15. Provide and maintain in safe adequate condition all staging and scaffolding required for the proper execution of the work of this Section.
16. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.10 PROTECTION OF WORK AND PROPERTY

A. Be responsible for the care and protection of all work included under this Section until it has been tested and accepted.

B. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be replaced with equal material or equipment at the option of the Architect and Owner.

C. Materials and equipment stored for this project shall be protected and maintained according to the manufacturer's recommendations and requirements and according to the applicable requirements of NFPA 70B.

D. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen and make good any damage caused.

E. Use caution to avoid damage to existing work, and to prevent harm to personnel working in all areas.

F. Observe all safety precautions and requirements for the construction.

G. When open-flame or spark producing tools such as blower torches, welding equipment, etc., are required in the process of executing the work, the General Contractor shall be notified not less than twenty four hours in advance of the time that the work is to begin and the location where the work is to be performed. Provide, where necessary, fire protective covering and maintain a constant non-working fire watch where work is being performed and until it is completed.

H. The General Contractor and the Installer are responsible for initiating, maintaining, and supervising all safety precautions and requirements during construction.

1.11 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with the respective trades responsible for installing interface work, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.

B. Continuity of all services shall be maintained in all areas which will be occupied or temporarily relocated during the construction period. If an interruption of service becomes necessary, such shall be scheduled in advance, made only upon consent of the Owner and at a time outside normal working hours as the Owner shall designate.

C. Refer to the overall scheduling of the work of the project. Schedule work, process Submittal and order materials and equipment to conform to this schedule and install work to not delay nor interfere with the progress of the project.

D. Inform Architect immediately of any delays or potential delays. Furnish manufacturer's letter to verify order date, equipment delays, expected shipment date, order number, and potential remedies to speed up delivery. Any costs to speed up delivery shall be implemented at no cost to the project if the equipment or material was not ordered as soon as possible after Contract award or within the time frames indicated with the Submittal.

E. Include premium time required to comply with the project scheduling and phasing.

F. Be aware of, and plan for, project scheduling and phasing. Provide for complete continuous operation of all systems. Coordinate scheduling and phasing with the Architect, Owner, other Trades, and the General Contractor.

1.12 WARRANTY

A. Voice and Data Cabling Warranty: The products that shall best support the needs of the project, and provide the highest level of system performance over the life of the facility, shall be a voice and data cabling system that is made up of system components designed, manufactured and installed as a total system solution. This requirement also applies to data patch cords specified in this Section; e.g. Ortronics patch cords shall be used with Ortronics jacks and patch panels.

B. Provide a Manufacturer's Extended Product Warranty that covers product defects for all passive components of the Voice and Data Cabling System. Passive components are defined as those exhibiting no gain or contributing no energy to the Data Cabling System and include but are not limited to cabling, connectors, outlets, patch panels, patch cords, racks as outlined in PART 2 of this Specification.

1. The following shall be covered by the Manufacturer's Extended Product Warranty:

   a. All passive components that comprise the Voice and Data Cabling System will be free from manufacturing defects in material of workmanship under normal and proper use.
   b. All passive components that comprise the Voice and Data Cabling System shall exceed the specifications of ANSI/TIA/EIA 568B series, and exceed ISO/IEC 11801 standards, including all subsequent changes to these standards that are in effect at the time of bidding, and shall meet or exceed the performance specifications as outlined in PART 2 of this Specification.
   c. The installation shall exceed the insertion and return loss, attenuation and near end crosstalk (NEXT) requirements of ANSI/TIA/EIA 568B series and the ISO/IEC 11801 standards for cabling links/channel configurations specified in these standards including all subsequent changes to these standards that are in effect at the time of bidding.
   d. Each Voice and Data Channel shall be capable of delivering data at 1.2 Gbps between active network electronics. A Data Channel is comprised of all passive components including cabling, connectors, patch panel port, and patch cords, with up to a total of 4 connections between Owner's network electronics (not in the contract).

2. Upon successful completion of the Voice and Data Cabling System installation by the Communication Systems Installer, and subsequent inspection by an authorized representative of the Manufacturer of the passive components, the Owner shall be provided with Registration Certificate, from the Manufacturer, registering the Installation.
3. Duration of Warranty: The warranty shall run for 20 years from the Date of Substantial Completion of the Project, unless the Registration Certificate is issued by the Manufacturer at a later date, in which case the warranty shall run for 20 years from the date that the Registration Certificate is issued.
4. The Extended Product Warranty is applicable to the Voice and Data Cabling System passive components at the original site of installation. Under the Extended Product Warranty, the Manufacturer of the passive components shall either repair or replace the defective product(s) at the Manufacturers cost. This includes the replacement or repair cost of defective materials and the cost of labor to repair or replace any and all defective products.
5. The Communication Systems Installer shall provide a Manufacturer's warranty that the Voice and Data Cabling System shall be free from defects which prevent operation of the specific applications for which the original Voice and Data Cabling System was designed to support, including but not limited to: 10Base-T; 100Base-T; 52/155 Mbps ATM; 622Mbps 64-CAP ATM; 1000Base-T Gigabit Ethernet.

1.13 MAINTENANCE

A. Provide installers maintenance contract quote, upon request, for a period equal to warranty.

B. Upon receipt of notice from the Owner of failure of any part of the systems during the warranty period, the affected parts shall be replaced. Any equipment requiring excessive service consisting of more than two unscheduled service calls, shall be considered defective and shall be replaced.

C. Response times to warranty issues shall differ according to the level of the problem.

1. A problem is considered to be corrected when the system and its components operate according to specified requirements.
2. Warranty work shall be performed according to the procedures of the Owner, its staff and tenants and their normal operations.

1.14 SEISMIC REQUIREMENTS

A. Equipment and work shall meet the restraint requirements per the Massachusetts Building Code.

1.15 FUNCTION AND OPERATION

A. The intended function of the data communications cable system is to transmit data signals from a central location to several individual data outlet locations. Upon completion of the work outlined in this specification, the system shall be capable of transmitting data signals at a rate of 1000 Mbps.

B. The multimode optical fiber cable system shall be capable of transmitting signals with a minimum bandwidth of 500 MHz at both 850 or 1300 nm. The cumulative signal loss, through connectors, jumpers, couplers, and fiber cable, shall be less than 10 dB. The singlemode optical fiber cable system shall be capable of transmitting signals with a bandwidth of up to 500 MHz at both 1300 and 1550 nm. The cumulative signal loss, through connectors, jumpers, couplers, and fiber cable, shall be less than 10 dB.

C. Work station cable, from the HC to the work area, shall be installed in accordance with EIA/TIA-568-A specified installation practices, EIA/TIA TSB 67 recommended installation practices, manufacturer specified installation practices, and shall be capable of transmitting a signal at 1000 Mbps with acceptable attenuation and cross-talk measurements. The entire work station cable system, including wiring blocks, cable, and telecommunications outlets shall be tested for Category 6 compliance.

1.16 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: One of each type.
2. UTP 4-pair Station Cable: 1,000 feet.
3. UTP Backbone Cable: 300 feet.
4. Patch-Panel Units: One of each type.
5. Device Plate: 10 of each type.

PART 2 - PRODUCTS

2.1 GENERAL

A. Throughout Part 2, material quantities are given. These quantities are given for reference purposes only. It is the responsibility of the Contractor to provide appropriate quantities of materials to provide a complete, functional system.

B. Equipment shall be installed in accordance with Technology drawings. General installation provisions are as follows:

1. Equipment Racks: Equipment racks shall be assembled and mounted in locations shown in the Drawings and as described herein. Each rack shall be assembled in accordance with the manufacturer's instructions and recommendations. Each rack shall be mounted such that the side rails are plumb. Each rack shall be affixed to the building structure at each of the mounting holes provided. Attachment shall be by 1/2 in X 1-1/4 in. lag bolts. A 3/8" pilot hole shall be drilled for each lag bolt. Each bolt shall be tightened to the extent that it holds the mounting hardware firmly, but not so tight as to distort the hardware or strip the threads. Equipment racks are to be co-located with the quadplex power outlets to allow for easy connection of racked equipment to the power system.
2. Wiring Blocks and Wire Management Components: Where required, wiring blocks and wire management components shall be mounted to the plywood backboard. Wiring blocks and wire management shall be mounted in accordance with the attached drawings. Each device shall be mounted such that its horizontal dimension is level. In cases where more than one device is mounted, they shall be aligned vertically. Each device shall be affixed to the plywood backboard by means of screws suitable for fastening to plywood. A minimum of four of the mounting holes provided shall be utilized for fastening. Screws shall be tightened to the extent that they hold the device snug to the backboard, but not so tight as to distort or damage the device. Wiring blocks shall be terminated in accordance with the manufacturer's instructions and recommendations. Installation of accessories shall also be conducted in accordance with the manufacturer's instructions and recommendations.

2.2 COMMUNICATION EQUIPMENT ROOM FITTINGS

A. SUMMARY

Section Includes:

1. Telecommunications mounting elements.
2. Pathways
3. Telecommunications equipment racks and cabinets
4. Grounding.

B. COORDINATION: Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
5. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

C. PATHWAYS

1. General Requirements: Comply with TIA/EIA-569-A.
2. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

    a. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
    b. Support brackets with cable tie slots for fastening cable ties to brackets.
    c. Lacing bars, spools, J-hooks, and D-rings.
    d. Straps and other devices.

D. EQUIPMENT FRAMES (RACKS)

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. APC
    b. Cooper B-Line, Inc.
    c. Hubbell Premise Wiring.
    d. Panduit
    e. Or equal

2. Floor-Mounted Racks: Modular-type, four-post quick rail, aluminum construction.

    a. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
    b. Baked-polyester powder coat finish.
    c. Refer to drawings for rack configurations.

3. Cable Management for Equipment Frames:

    a. Metal, with integral wire retaining fingers.
    b. Baked-polyester powder coat finish.
    c. Vertical cable management panels shall have front and rear channels, with covers.
    d. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

4. Power Strips: Comply with UL 1363.

    a. Rack mounting.
    b. Receptacles: Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles for each power strip. Provide two in each rack. Power strip shall connect with a twist lock to match receptacle on cable tray.
    c. LED indicator lights for power and protection status.
    d. LED indicator lights for reverse polarity and open outlet ground.

e. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
f. Cord connected with 15-foot line cord.
g. Rocker-type on-off switch, illuminated when in on position.
h. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
i. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

E. GROUNDING

1. Comply with requirements in 26 00 10 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
2. Telecommunications Main Bus Bar:

a. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
b. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
c. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
d. Comply with ANSI-J-STD-607-A.

3. Bond all racks and cable tray to TMGB.

F. LABELING

1. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.3 UTP CABLE (BACKBONE)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable
2. CommScope
3. Mohawk; a division of Belden CDT.
4. Or equal

B. Description: Multi-pair Backbone Cable: Category 5e, 100-ohm, 25-pair UTP binder groups covered with a gray thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 5e.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications: Type CMP, complying with NFPA 262.

C. Multi-pair backbone cables: Provide copper backbone cable that meets or exceeds the following specifications:

1. Electrical Specifications:

Maximum DC Resistance	28.6 Ω/1,000 ft (9.4 Ω/100m)
Maximum DC Resistance Unbalanced	5 percent
Maximum Capacitance Unbalanced (pair to ground)	1,000 pF/1000 ft. (328 pF/m)
Mutual Capacitance @ 1kHz	18 nF/1000 ft (5.9 nF/100 m), max.

2. Attenuation (dB/100 m [328 ft.]):

Frequency	Attenuation (Max.)
1.00 MHz	2.3 dB
4.00 MHz	4.9 dB
10.00 MHz	8.5 dB
16.00 MHz	12 dB

3. Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]:

Frequency	Pair-To-Pair NEXT (Max.)
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB
10.0 MHz	10.2 dB
16.0 MHz	9.2 dB

2.4 FIBER INNERDUCT

A. DESCRIPTION: From the MDF to each IDF, segments of optical fiber innerduct shall be installed.
1. Quantities Required: Innerduct runs do not have to be continuous throughout, breaks are expected at the pull boxes. Contractor is responsible for determination of actual lengths of innerduct required. Enough innerduct shall be provided and installed to extend from the fiber service loop in the MDF to the fiber service loop in each IDF. If the route passes through a pull box, the segments of innerduct shall extend twelve inches into the pull box. If the route passes through an enroute HC, each segment of innerduct shall extend at least twelve inches beyond the end of the service conduit.

B. INSTALLATION: Fiber innerduct shall be installed in accordance with manufacturer's instructions and industry standards. Within the equipment rooms, the innerduct shall extend from the end of conduit to four feet above the floor and shall be affixed to the backboard by means of clamps designed for that purpose. Care shall be taken to avoid kinking the innerduct or applying excessive tension during the installation process.

2.5 FIBER DISTRIBUTION

A. DESCRIPTION: From the MDF to each IDF a continuous segment of fiber cable shall be provided.
1. Product: 12 strands multi-mode 50/125 UM OM3 laser optimized and 6 strands single-mode 8.3/125 UM.

2. Quantities Required: The contractor is responsible for determination of actual segment lengths. Actual quantities will be determined by the routing established by the electrical engineer.
3. Required Accessories and Quantities:
   a. Kit of Parts: Sufficient quantities to block and buffer both ends of each cable segment.
   b. Sealant: Sealant sufficient quantities to block each end of each cable segment.

B. INSTALLATION: Installation shall be conducted following guidelines established by the product manufacturer and industry standards.
1. Fiber Optic Cable: During installation of the optical fiber cable segments into the conduit system, special care shall be taken to avoid damage to the cable. While under pulling tension, the cable shall not be bent into a curve with a radius of less than 20 times the cable diameter. Pulling tension shall not exceed manufacturer's recommended maximum tensile load. Contractor shall utilize a winch with tension control or a "break-away" link designed to break away at or below the recommended maximum tension.

C. The optical fiber cable shall be routed through the existing conduit and onto the appropriate HC backboard. Routing on the backboard shall be straight and plumb. A minimum ten foot service loop shall be provided at each terminal location. Refer to Drawings for cable configuration.

2.6 WORK STATION CABLE

A. DESCRIPTION: From each MDF, 4-pair enhanced Category 6A cables shall be routed to each work station (data outlets).

1. Product:

   a. Copper 4-pair UTP:

      1) UTP cables shall:

         a) Be manufactured by one of the following:
         b) Hitatchi Cable Manchester
         c) Berk-Tek
         d) Commscope
         e) General Cable
         f) Mohawk
         g) Or equal
         h) Be 100 Ω 4-pair, category 6A cable.

   a. Shall be rated for the environment in which it is installed.

2. Required Accessories and Quantities (Hard Wall Locations):

   a. Work Station: Panduit CFPLS** stainless steel Single Gang, Single Port Face plate. Using Panduit CMB**-X blank modules to fill unused ports. Refer to drawings for two, three, and four gang configurations. Modules shall be CJ688TP** – color to be selected by engineer.

3. Work Area Equipment Cords: The Work Area Equipment Cords shall meet or exceed the following criteria:

   a. Modular Equipment Cords: Category 6A

4. CAT6A cables shall be small diameter cable. The nominal cable outside diameter shall be no greater than 0.27 in. and distance limitations shall be no less than 295 ft.
5. Category 6A, modular equipment cords shall:

    a. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame-retardant jacket.
    b. Be equipped with modular 8-position (RJ45 style) plugs on both ends, wired straight-through with standards compliant wiring.

6. Use modular plugs which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, and have 50 microinches minimum of gold plating over nickel contacts.
7. Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.
8. Utilize cable that exhibit power sum NEXT performance.

    a. Be available in several colors with color strain relief boots featuring a snagless design.
    b. Provide (2) foot patch cord per data jack shown on drawings. Coordinate with owner exact sizes required in the closet side.
    c. Be made by an ISO 9001 and 14001 Certified Manufacturer.
    d. Electrical Specifications:
    e. DC resistance per lead: 9.38 Ω / 100 m maximum.
    f. Input impedance without averaging: 100 Ω + 15 percent from 1 to 100 MHz.
    g. 100% transmission tested with laboratory grade network analyzers for proper performance up to 1000 MHz. Vendor shall guarantee cords are compatible with category 6 links.

9. UL VERIFIED (or equivalent) for TIA/EIA proposed category 6 electrical performance.
10. UL LISTED 1863.
11. All information outlets for 100 Ω 22-26 AWG copper cable shall:

    a. Be available in blue, black, white, gray, ivory and light ivory.
    b. Accommodate a minimum of two 8-position / 8-conductor modular jacks.
    c. Utilize compliant pin technology 110 style insulation displacement connectors which allows the use of a 4-pair impact tool.
    d. Allow for a minimum of 200 re-terminations without signal degradation below standards compliance limit.
    e. Be constructed of high impact, flame-retardant thermoplastic.
    f. Be available in a screened version for 100 Ω ScTP cable.
    g. Be made by an ISO 9001 and 14001 Certified Manufacturer.
    h. Electrical Specifications:
    i. ANSI/TIA/EIA-568-B1, B2, B3 and ISO/IEC 11801 proposed category 6 compliant.
    j. The following requirements shall also be met (NEXT Loss and FEXT tested in both Differential and Common Mode):

Parameters	Performance	Performance @ 100 MHz *
NEXT Loss	+ 3.0 dB	43.0 dB
FEXT	+ 3.0 dB	43.0 dB **
Insertion Loss (Attenuation)	+ 40 percent	.24 dB
Return Loss	+ 6 dB	20 dB
LCL	40 dB (1-100 MHz)	**

B.

C. INSTALLATION: Installation shall be conducted in accordance with guidelines established the manufacturer and industry standards. Wall Plates shall be mounted such that their vertical dimension is plumb. Each wall plate shall be labeled with its respective work station number. Each modular mounting frame shall be labeled with its respective work station number.

D. Technical Requirements: Horizontal cabling: 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/closet. It consists of the telecommunications outlet/connector, the horizontal cables, optional consolidation point, and that portion of the cross-connect in the telecommunications room/closet serving the horizontal cable.

1. Cable Types: All UTP and fiber optic cables shall conform to the following standards:

a. ANSI/TIA-568C.0 Generic Telecommunications Cabling for Customer Premises
b. ANSI/TIA-568C.1 Commercial Building Telecommunications Cabling
c. ANSI/TIA-568C.2 Balance Twisted Pair Telecommunications Cabling
d. ANSI/TIA-568C.3 Optical Fiber Cabling and Components Standard
e. Including all applicable addenda) and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard (latest amendment and including all applicable addenda).
f.

Input Impedance	Bonded-Pair		Non-bonded Pair
100 +	12	1-20 MHz	-----
100 +	15	20-250 MHz	1-100 MHz
100 +	20	250-350 MHz	-----
100 +	22	350-625 MHz	100-200 MHz
100 +	32	-----	200-625 MHz

g. Copper: The following cable specifications shall also be met by the cable manufacturer for 4-pair UTP, premium category 6 cables:

1) Attenuation: Qualified Cables shall exhibit worst case attenuation less than the values derived using the equations shown in the chart below from 1 MHz to the highest referenced frequency value. Worst case qualified cable attenuation performance for selected frequency points of interest is also provided.

Attenuation Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case			$\leq 1.82\sqrt{f} + .017 \cdot f + \frac{0.20}{\sqrt{f}}$	
Frequency Points of Interest	MHz			
	100		19.8 dB	
	200		29 dB	
	300		35.3 dB	

h. Near End Crosstalk (NEXT) Loss:

1) Qualified Cables shall exhibit worst case NEXT Loss greater than the values derived using the equations shown in the chart below from 1 MHz to the highest referenced frequency value. Worst case qualified cable NEXT Loss performance for selected frequency points of interest is also provided.

NEXT Loss Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case Cable NEXT Loss			$\geq 76 - 15\log(\frac{f}{0.772})$	
Frequency Points of Interest	MHz		44.3 dB 39.8 dB 37.1 dB	
	100 200 300			

i. Power Sum Near-End Crosstalk (PSNEXT) Loss:

1) Qualified Cables shall exhibit worst case PSNEXT Loss greater than the values derived using the equations shown in the chart below from 1 MHz to the highest referenced frequency value. Worst case qualified cable PSNEXT Loss performance for selected frequency points of interest is also provided.

PSNEXT Loss Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case PSNEXT Loss			$\geq 74 - 15\log(\frac{f}{0.772})$	
Frequency Points of Interest	MHz		42.3 dB 37.8 dB 35.1 dB	
	100 200 300			

j. Equal Level Far-End Crosstalk (ELFEXT):

1) Qualified Cables shall exhibit worst case ELFEXT greater than the values derived using the equations shown in the chart below from 1 MHz to the highest referenced frequency value. Worst case qualified cable ELFEXT performance for selected frequency points of interest is also provided.

ELFEXT Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case ELFEXT			$\geq 70 - 20\log(\frac{f}{0.772})$	
Frequency Points of Interest	MHz		27.8 dB 22.7 dB 18.2 dB	
	100 200 300			

k. Power Sum Equal Level Far-End Crosstalk (PSELFEXT):

1) Qualified Cables shall exhibit worst case PSELFEXT Loss greater than the values derived using the equations shown in the chart below from 1 MHz to the highest referenced frequency value. Worst case qualified cable PSELFEXT performance for selected frequency points of interest is also provided.

PSELFEXT Loss Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case PSELFEXT			$\geq 67 - 20\log(\frac{f}{0.772})$	
Frequency Points of Interest	MHz		24.8 dB 18.7 dB 15.2 dB	
	100 200 300			

l. Return Loss:

1) Qualified Cables shall exhibit worst case Return Loss greater than the values derived using the equations shown in the chart below from 1 MHz to the highest referenced frequency value. Worst case qualified cable Return Loss performance for selected frequency points of interest is also provided.

Return Loss Limits Table							
				System 6SM			
Frequency Range				1-350 MHz			
Worst Case Return Loss				Frequency (MHz)	Return Loss (dB)		
				≤ f <10 10 ≤ f < 20 20 ≤ f ≤ 300	21 +4·log(f)dB 25 dB 25 –7·log(f/20)		
Frequency Points of Interest	MHz						
	100 200 300	-		20.1 dB 18 dB 16.8 dB			

m. Propagation Delay (ANSI/TIA/EIA-568-A-1):

1) Qualified Cables shall exhibit worst case Propagation Delay less than the values derived using the equations shown in the chart below from 1 MHz to the highest referenced frequency value. Worst case qualified cable Propagation Delay performance for selected frequency points of interest is also provided.

Propagation Delay Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case Propagation Delay			$< 476 + \frac{36}{\sqrt{f_{MHz}}}$	
Frequency Points of Interest	MHz			
	100		480 ns	
	200		479 ns	
	300		478 ns	

n. Delay Skew (ANSI/TIA/EIA-568-A-1):

1) Qualified Cables shall exhibit worst case Delay Skew less than the values specified in the chart below per 100 m from 1 MHz to the highest referenced frequency value.

Delay Skew Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case Delay Skew	MHz			
	100		25 ns	
	200		25 ns	
	300		25 ns	

o. Longitudinal Conversion Loss (LCL):

1) For all categories of 100 Ω unshielded and screened cables, the worst case calculated LCL for any pair in a 100 m cable shall not be less than 35 dB, from 1 MHz to the highest referenced frequency for each performance category. LCL measurements shall be performed in accordance with ITU-T Recommendation O.9 (November, 1988) or equivalent. Calculated LCL performance shall be determined by subtracting the test balun loss correction factor (as specified by the balun manufacturer) from the measured value at all frequencies.

LCL Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case Delay Skew	MHz			
	100		35 dB	
	200		35 dB*	
	300		35 dB	

p. Longitudinal Transfer Conversion Loss (LCTL):

1) For all categories of 100 Ω unshielded and screened cables, the worst case calculated LCTL for any pair in a 100 m cable shall not be less than 35 dB, from 1 MHz to the highest referenced frequency for each performance category. LCTL measurements shall be performed in accordance with ITU-T Recommendation O.9 (November, 1988) or equivalent. Calculated LCL performance shall be determined by subtracting the test balun loss correction factor (as specified by the balun manufacturer) from the measured value at all frequencies.

LCTL Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case Delay Skew	MHz			
	100		35 dB	
	200		35 dB*	
	300		35 dB*	

q. Attenuation to Crosstalk Ratio (ACR):

1) Using "pair-to-pair NEXT Loss", all Qualified Cables shall exhibit worst case ACR performance for the specified frequency range shown in the following table.

ACR Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case ACR	MHz			
	1-80		24.1 dB	
	80-100		24.1 dB	
	1-100		24.1 dB	
	100-300		.5 dB	

PSACR Limits Table				
			System 6SM	
Frequency Range			1-350 MHz	
Worst Case PSACR	MHz			
	1-80		22.1 dB	
	80-100		22.1 dB	
	1-100		22.1 dB	
	100-300		-1.5 dB	

r. Transfer Impedance:

1) Surface+ Transfer Impedance is specified for ScTP cables and is determined by the formula below in mΩ/m where f = frequency. All qualified ScTP cables shall have a margin greater than or equal to the values specified in the following table.

$$T_{cable} = 37 + 4f + 4\sqrt{f} + 5\sqrt[3]{f}$$

Transfer Impedance Limits Table			
Margin 1-100 MHz		System 6SM	
Transfer Impedance		10 %	

2.7 MAIN DISTRIBUTION FACILITY (MDF)

A. DESCRIPTION: The equipment shall be installed in accordance with Drawings.

1. Products and Quantities:

a. Equipment Rack: - As specified.
b. Fiber Interconnect: Panduit FRME24 rack mount fiber optic enclosure or equal. Supply and install as many as necessary to service all fiber strands entering the MDF.
c. Modular Patch Panels: Panduit angled patch panel or equal: 48-port patch panel wired Category 6A Patch Panel. One port for each workstation served from the MDF with a minimum of 12 spare ports are required. Provide CAT6A angled patch panel for wireless CAT6A ports. If the number of workstation cables, plus required spare count 12 is greater than 48, then a second 48-port patch panel is required. Supply and install as many patch panels in the MDF as necessary to service all workstation cables plus the required spare count. Provide separate CAT 6A patch panels as required for CAT 6A cables serving wireless access point outlets.
d. Patch Cables: Panduit UTPSPXX-** or equal where XX is the length in feet and ** is the color. The length shall vary between 3' and 15' and shall be determined by the owner. Colors shall also be determined by the owner. A minimum of five different color patch cables shall be carried for different systems.

2. Required Accessories and Quantities:

a. Adapter Panels: Panduit FAP6WEIDSC – 6 Port Duplex Multimode SC Adapter Panels.
b. Fiber Jumpers: Panduit F6D3-3M3Y, 3 meter, Duplex, 50 micron OM3, SC to LC Fiber and ST to LC Fiber Jumper or equal.
c. Cable Management: Panduit WMPH2E Front/Rear cable manager or Panduit WMPLS Low Profile Cable Manager or equal.
d. Cable Management Rings and Strain Relief: Panduit WMBV1 21 in. x 5 in. Vertical Manager Ring, Panduit WMBV2 2 in. x 5 in. Vertical Manager Ring and/or Panduit WMSRC1 or WMSRC2 strain relief clips. Provide and install sufficient quantities to conform to attached Drawings.

B. INSTALLATION: Installation shall be conducted in accordance with manufacturer's recommendations, industry standards, and this specification. Installation includes complete assembly and mounting of the fiber interconnect equipment, dressing the fiber and copper cables, complete assembly and mounting of the equipment rack, and mounting of the wiring blocks. Equipment shall be mounted in accordance with attached Drawings.

2.8 TESTING AND DOCUMENTATION

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6 and 6A marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Provide test instruments that meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Multi-pair Voice Riser Tests:

    a. Test each pair of multi-pair voice riser cables for proper polarity; no reversals; no transpositions; continuity; no shorts; no AC voltages; no DC voltages; no opens; and proper numbering at each termination.
    b. Bring cables and/or pairs not meeting the requirements of the standard into full compliance, at no additional cost to the Owner.
    c. Document cable testing in accordance with Submittals Article. Provide a table of test results in a 3-ring binder submitted with the as-built Drawings.

6. Category 6A Data, and Voice UTP Cable Testing:

    a. Test voice and data jack in each Outlet for Category 6A ANSI/TIA/EIA 568B series compliance, using a Certified Level III testing instrument. Tests shall verify both the integrity of all conductors and correctness of the termination sequence. Tests shall also include length, mutual capacitance, characteristic impedance, attenuation and near-end and far-end crosstalk. Testing shall be performed between modular jacks at the Outlets and the modular jacks at the patch panel field.
    b. The Communication Systems Installer shall bring cables and/or pairs not meeting the requirements of the standard into full compliance, at no additional cost to the Owner.
    c. Document cable testing in accordance with Submittals Article. Provide a table of test results in a 3-ring binder submitted with the as-built Drawings.

D. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

    Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

E. Document data for each measurement. Print data for submittals in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

F. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

G. End-to-end cabling will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

2.9 CABLE TELEVISION SYSTEM

A. Furnish and install cable and all outlets. Cabling shall be provided as indicated on the drawings.

B. Television outlet locations shall have wall boxes mounted both at 18 in. above finished floor unless otherwise indicated. The boxes shall be 4 in. square with double gang plaster ring, and cover for cable outlet and duplex receptacle where shown on Plan. At other locations, provide single gang plaster ring and cover.

C. Provide one RG-6 quad shielded cable per CATV outlet run above ceiling to MDF room.

2.10 TWO WAY CALL BOXES SYSTEM

A. Summary:

1. Section Includes: Area of Refuge Base Stations, call boxes and signage.

a. The Area of Refuge Base Station is to be located at a central control point on the first floor or as determined by local Authority having jurisdiction. Rath Call Boxes are to be located on all floors above and below the first floor.
b. The Area of Refuge Base Station must be capable of handling a minimum of 5 Rath Call Boxes. Visual indicators on the base station allow Rescue personnel to know which Area of Rescue Call Box needs assistance. The Base Station must allow Rescue personnel to speak to all Call Boxes or individual Call Boxes.
c. The Emergency communication hardware shall comply with the Americans with Disabilities Act (ADA). The phone shall have the ability to be programmed with up to 5 emergency phone numbers. Upon activation of the emergency push button, a call will be automatically placed to the Base Station. If no one answers at the Base Station, the Call Box must dial a secondary location outside the building to activate two way off-site person to person voice communications.

B. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Rath Area of Refuge
b. Aiphone
c. Housing Devices, Inc.
d. Or Equal.

C. Functional Description of System

1. Construction

a. The Area of Refuge Base Station (models 2500) must have a stainless steel or powder coated steel housing, red coil cord emergency Handset, be 120vac
b. powered, and maintain back-up power for 4 hours.
c. The Area of Refuge Call Boxes (models 2100) must be in full compliance with Americans with Disabilities ACT (ADA). Call Boxes require a hands-free speakerphone with an LED to indicate status of call.

d. The Area of Refuge Call Boxes must allow the programming in of a specific location message of the Call Box. This allows Rescue personnel to know the location of the activated Call Box.
e. The Area of Refuge Call Boxes are to be located no higher than 48" above ground level to ensure conformance with the ADA requirements.
f. The Area of Refuge Call Boxes must have a Braille faceplate located no higher
g. than 48" for front reach and 54" for side reach above ground level to ensure
h. conformance with the ADA requirements.
i. The Area of Refuge Base Station must provide an audible and visual indicator that
j. a Call Box has been activated.
k. The area of Refuge 24vac Power Supply model 2500-PWR24 must be capable of
l. supplying power to a minimum of 40 Call Boxes. (does not power Base Station)

2. Mounting

a. The Area of Refuge Base Station is to be mounted on a wall surface or flush mounted.
b. Areas of Refuge Call Boxes are to be wall surface or flush mounted.

3. Electrical

a. The Base Station is to be powered by 120vac. Call Boxes are to be powered by Rath 24vac Power Supply model 2500-PWR24.
b. Call Boxes must have a battery back-up capable of providing up to 4 hours of electrical back-up in case of building power failure.
c. Base Station must have a battery back-up capable of providing up to 4 hours of electrical back-up in case of building power failure.
d. System shall be in compliance with all state and local Electrical Codes.

4. Communications

a. The Call Boxes shall have an ADA compliant and vandal resistant speakerphone.
b. The Call Boxes shall be Hands-Free and be a push-button-once to talk system.
c. Once the button has been pushed, the Call Box will call the Base Station. If no answer at the Base Station, it will automatically call preprogrammed emergency numbers. The Call Box must be capable of being programmed with up to 5 emergency numbers.
d. Call Box shall have Location Message capability. Call Box must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. Call Box shall notify called party of the location of the call upon being received at the emergency dispatch center.
e. Call Box shall be capable of allowing the called party to replay the Location Message if necessary to ensure an understanding of the caller location.
f. If system is not attended to 24 hours a day, the Call Box must dial a secondary location outside the building to activate two way off-site person to person voice communications.
g. Once call has been made (button pushed), the call can only be terminated by the called party.
h. Call Box must have a red LED that will light up upon push of the button. The light shall be a solid color when the Call Box is activated, and will flash when call has been answered.
i. The Call Box must be capable of being programmed and reprogrammed on-site and remotely.

5. Standard Call Box features:

    a. Five number programming.
    b. Operating Temperature of between -40˚F to +150˚F (-40˚ to + 65˚ C)
    c. Programmable passwords.
    d. On-Site or Remote Programmable.

6. Monitoring

    a. Off-Site monitoring of the system shall be provided as requested by the Owner.
    b. Must be a UL Listed monitoring service provider
    c. Minimum 3 year agreement for monitoring of the system.
    d. Call Boxes shall dial the monitoring service.

7. Graphics

    a. Area of Refuge Base Station must include wording identifying the location of each
    b. Call Box and light an LED when a particular Call Box has been activated.
    c. Call Box wording must include “Help Phone”, “International Phone symbol” and raised Braille lettering.

D. Startup Service:

1. Engage a factory-authorized service representative to perform startup service.

    a. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
    b. Complete installation and startup checks according to manufacturer's written instructions.

E. Adjusting:

1. On-Site Assistance: Engage a factory-authorized service representative to provide onsite assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
2. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

F. Warranty:

1. The base station and call boxes shall be warranted for a period of one year.

G. Demonstration:

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the system.

2.11 PUBLIC PAGING SYSTEM

A. Provide public paging system as described herein and as shown on the Drawings. All wiring for audio systems shall be color grey. Paging system shall be T.O.A. or equal.

B. Provide in accordance with the manufacturer's instructions all wiring and equipment required for the erection of a complete system.

C. The system shall consist of a complete paging system with all features as herein specified and shown on drawings. The system shall contain the following components.

1. The amplifier shall deliver an audio output of a minimum of 150 watts RMS per channel with a total harmonic distortion of .05% at 1 kHz rated power. Output regulation shall be .5 dB (direct) 1.0 dB (Transformer).
2. The amplifier shall provide complete input and mixing facilities for 4 low-impedance microphone inputs, and auxiliary input. Each microphone input shall also include an overload circuit which permits microphone signals of up to 1 volt to be reproduced without any discernible increase in distortion.
3. Provisions shall be included for the telecommunications system or fire alarm control panel to take precedence over all other inputs for emergency announcement.
4. The amplifier shall include all circuitry and controls necessary to provide complete system equalization for optimum sound reproduction and maximum gain before feedback. The equalizer filters shall be of the 1 octave bandpass type having an individual range of 12 dB. A total on 9 individual filters shall be provided. Filter controls shall be slide type.
5. The amplifier shall have auxiliary program inputs, to allow user of input sources such as a mixer, tuner, Zetron input, telephone, radio. Signal level at this input is controlled by the program level control and is fed to the master output. This auxiliary input shall also mute upon emergency messages.

D. The paging system shall have a telephone interface module to transmit emergency messages from a telephone handset throughout the entire facility.

E. Loudspeakers (Sallyport) (Apparatus Bay):

1. Sound reinforcement loudspeaker shall be a self-contained, broad dispersion. The frequency range shall be 50 Hz to 22,000 Hz. The speaker shall have a sensitivity of 89.5 dB SPL, 100 dB at 1 meter, or more, and shall have a continuous power handling capacity of 125 watts rms. Provide equipment soundtube RS800i or equal.
2. Each unit shall be provided with a hanging kit for every speaker. Provide equipment by Pro Acoustics, Inc. or approved equal.
3. Each unit shall be provided with a 125 watt line matching transformer designed for use with the specified speaker. Provide equipment by QSC or approved equal.

F. The main sound reinforcement ceiling loudspeakers speakers, as shown on plans, shall be Lowell 8C5W-T251 8"Speaker Assembly. The assembly shall be a 8" Dual cone speaker with 25/70 volt line matching transformer and 5oz. ceramic magnet assembled to a Lowell WB-B Baffle or approved equal. Power rating shall be 15 watt RMS; voice coil shall have an impedance of 8 ohms and measure 1" in diameter. The circular baffle shall be 12 3/4" in diameter and 3/8" deep. It shall be constructed of 22 gauge cold rolled steel, with white baked on epoxy finish.

2.12 MISCELLANEOUS CABLING SYSTEM

A. Provide and terminate all speaker, microphone, antenna, cabling per manufacturer’s recommendations for a completely operational system as specified.

B. Sound/Speaker cabling shall be home run and looped directly to applicable headend termination board, as specified. All cable runs shall be free from in-line splices. Insulate all cable shields (at field device end) from field grounds by cutting and taping shields.

1. Office speakers, conference room speakers, work room speakers, exterior speakers and others areas that have only one (1) public address speaker shall each be individually home run, without splices, back to their respective sound system headend. Provide 22 AWG solid shielded speaker cables.
2. Hallways and other areas that have multiple speakers, may have a maximum of eight (8) speakers per speaker loop home run, without splices, back to their respective sound headend. Provide 18 AWG stranded speaker cables.
3. Loud Speakers areas that have multiple speakers, may have a maximum of four (4) speakers per speaker loop home run, without splices, back to their respective sound headend. Provide 18 AWG stranded speaker cables.

2.13 ELEVATOR TELEPHONE LINE FAULT MONITOR

A. Provide Line Fault Monitor designed for connection across incoming telephone lines on systems using telephone dialers (e.g., 612) or digital communicators (e.g., 678, 678UL-B. 793 or 794) or control/communicators. It will cause a signal to be generated if the telephone line between dialer or communicator and the central station is cut or shorted, or if incoming service is otherwise interrupted. The signal can be in the form of sounding the on-premises protective system's alarm bell (when the system is ON), or the lighting of a trouble indication lamp on an optional accessory tester (such as the 664 for non-UL Listed applications).

B. Monitor shall be mounted within a Listed control unit or other enclosure connect to intrusion alarm system on dedicated zone.

PART 3 - EXECUTION

3.1 GENERAL

A. Do not install equipment and materials which have not been reviewed by the Architect. Equipment and materials which are installed without the Architect's review or without complying to comments issued with the review shall be removed from the project when so instructed by the Architect. No payment will be made for unapproved or removal if it is ordered removed. The Installer shall be responsible for any ancillary costs incurred because of its removal and the installation of the correct equipment and materials.

B. Obtain detailed information on installation requirements from the manufacturers of all equipment to be furnished, installed or provided. At the start of construction, check all Contract Documents, including all Drawings and all Sections of the specifications for equipment requiring electrical connections and service and verify electrical characteristics of equipment prior to roughing.

C. Equipment and systems shall not be installed without first coordinating the location and installation of equipment and systems with the General Contractor and all other Trades.

D. Any and all material installed or work performed in violation of above requirements shall be re-adjusted and corrected by the Installer without charge.

E. Refer to all Drawings associated with the project, prior to the installation or roughing-in of the electrical outlets, conduit and equipment, to determine the exact location of all outlets.

F. After installation, equipment shall be protected to prevent damage during the construction period. Openings in conduits and boxes shall be closed to prevent the entrance of foreign materials.

G. Home runs indicated are not to be combined or reduced without written consent from the Architect.

H. All connections to equipment shall be made as required, and in accordance with the approved submittal and setting drawings.

I. Delivery, Storage and Handling:

1. Deliver, store, protect and handle products in accordance with recommended practices listed in Manufacturer's Installation and Maintenance Manuals.
2. Deliver equipment in individual shipping splits for ease of handling, mount on shipping skids and wrap for protection.
3. Inspect and report concealed damage to carrier within specified time.
4. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation. Meet the requirements and recommendations of NFPA 70B and the Manufacturer. Location shall be protected to prevent moisture from entering enclosures and material.
5. Handle in accordance with NEMA and the Manufacturer's recommendations and instructions to avoid damaging equipment, installed devices and finish.
6. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the Manufacturer shall be required to brace the equipment suitably to insure that the tilting does not impair the functional integrity of the equipment.

J. Site Observation:

1. Site observation visits will be performed randomly during the project by the Architect. Reports will be generated noting observations. Deficiencies noted on the site visit reports shall be corrected. All work shall comply with the Contract Documents, applicable Codes, regulations and local Authorities whether or not a particular deficiency has been noted in a site visit report.
2. Be responsible to notify the Architect ten working days prior to closing in work behind walls, raised access floors, ceilings, etc., so that installed work can be observed prior to being concealed.
3. Areas shall stay accessible until deficiencies are corrected and accepted. Notify the Architect when all deficiencies are corrected. Return reports with items indicated as corrected prior to re-observation by the Architect.

K. Project Open House:

1. If the Owner elects to have an open house at the end of the project, provide assistance to the Owner. Cooperate and provide manpower to operate and demonstrate systems during the open house as requested by the Owner.

3.2 EQUIPMENT RACKS, CABINETS AND BRACKETS

A. Securely mount equipment racks, cabinets and wall mounted relay brackets to the building structure. Proper supports such as 3/8 in. lag screws and expansion anchors shall be used. Proper quantity of supports shall be utilized. Drywall screws and other types of supports not specifically approved to support equipment are specifically prohibited. Submit mounting supports for approval before installation.

B. Position racks, cabinets, and wall mounted relay brackets in order to have minimum 3 foot clearance for easy access. Equipment racks, cabinets and relay brackets mounted on or against walls shall have 3 foot clearance in front of deepest component. Free standing equipment racks and cabinets shall have 3 foot clearance in front and rear of deepest components. Provide 3 foot clearance between free standing equipment racks or cabinets and any other obstruction to allow access from front to rear of rack or cabinet for maintenance.

C. The Electrical Contractor shall provide cable tray over each rack and cabinet as required to facilitate a neat and orderly installation of cables and to secure the top of the racks to the structure. Cables shall drop straight down to equipment racks. Cable trays shall be secured at both ends to the

D. structure and connected together as required for a complete contiguous installation. Utilize proper supports to support the cable tray to the building structure as well as the equipment rack and cabinet. Submit mounting supports for approval before installation.

E. Cable Management: All cables shall enter the wiring closet to within the equipment racks and/or brackets. Secure the bundle(s) to the rack strain relief and wire management behind the patch panels and cross connect block panels. Install horizontal and side-mounted vertical cable management panels and brackets for routing and management of patch cables. Maintain EIA/TIA and BICSI standards on bundling, supporting and bend radii.

F. Once the cabling system has been installed and terminated, install all active components and surge protected power strips into the racks, cabinets and wall mounted relay brackets.

G. Surge Protected Outlet Strips: Mount UPS and surge protected outlet strips per Manufacturer's directions. Refer to details on the Drawings for mounting location.

3.3 TERMINATIONS

A. All copper conductors of every cable shall be completely terminated at both ends.

3.4 CABLE PATHWAYS

A. Install cables in pathways provided by the Electrical Subcontractor or required under execution part of this Section.

B. Provide all equipment and cabling for a complete installed operating system. In general, pathways, outlet boxes and grounding are provided by the Electrical Subcontractor.

C. All pathways provided under this Section shall comply with fill capacities as per Code, EIA/TIA 569 and BICSI.

D. Cable bending radius shall not be less than minimum required by EIA/TIA and BICSI.

E. Cabling installed concealed shall be supported from the building structure (e.g. cable trays, J-Hooks, etc.).

F. Cables shall be installed no closer than 12 inches (305mm) to electrical equipment and wiring. When cables are required to cross power wiring, they shall only do so perpendicular to the power wiring. Telecommunications cabling and power wiring shall only cross each other the minimal number of times as required due to building design limitations.

G. Clearances: Clearances between cabling and other building systems as required by EIA/TIA 569 and BICSI shall be maintained throughout the building.

H. All cables shall be installed in a neat and workman-like manner. Cables shall be installed parallel and perpendicular to building elements.

I. Provide expansion fittings and adequate cable slack at all building expansion joints.

J. Fire/smoke seal all conduits, raceways, sleeves, slots, etc. where cables pass from one location to another.

3.5 SEALING OF PENETRATIONS AND OPENINGS

A. Environmental Seals

1. Provide seals on raceways exposed to widely different temperatures, as in refrigerated or cold storage areas. Install seal to prevent circulation of air from warmer to colder sections through the raceway.
2. Provide seals under device plates for outlets on walls between conditioned and non-conditioned spaces.
3. Provide outlet plate gasket seals at all work area outlets on interior and exterior walls.

3.6 SEISMIC SUPPORTS, SUPPLEMENTARY STEEL AND CHANNELS

A. Provide all supports, supplementary steel and channels required for the proper Seismic installation, mounting and support of all work installed under this Section.

B. All supports, supplementary steel and channels shall be furnished, installed and secured with all fittings, support rods and appurtenances required for a complete support or mounting system.

C. Supplementary steel and channels shall be firmly connected to the building construction in a manner approved by the Architect prior to the installation of same. Submit to the Architect, via the General Contractor, the locations proposed for using supplementary steel and channels for the support of equipment, fixtures and raceways. The submittal shall indicate the mounting methods, size and details of the supports, channels and steel; it shall indicate also that weight which the supports, channels and supplementary steel is to carry.

D. The type and size of the supporting channels and supplementary steel shall be of sufficient strength and size for seismic restraint and to allow only a minimum deflection in conformance with the channel and supplementary steel manufacturer's requirements for loading.

E. All supplementary steel and channels shall be installed in a neat and workmanlike manner parallel to the walls, floor and ceiling construction. All turns shall be made with 90 degrees and 45 degrees fittings, as required to suit the construction and installation conditions.

F. All supplementary steel, channels, supports, and fittings, shall be Underwriters' Laboratories, Incorporated, approved, be galvanized steel and be manufactured by Steel City, Unistrut, Power-Strut, T. J. Cope, Chalfant or approved equal.

G. Provide supports to meet the required Seismic rating as indicated under "Part One" of this Specification.

H. Provide beam clamps with set screws (C-clamp type).

I. Work under this Section shall be held in place by Seismic rated methods.

J. Supporting from the roof decking will not be acceptable.

K. Provide expansion anchors on masonry units or brick work. Power actuated supports will not be accepted.

L. Provide stainless steel or corrosion resistant supports in corrosive areas on wet or damp areas.

M. Support work from the building structure, independent of suspended ceilings, roof deck or other trades work. Where duct work, pipes, pipe racks, type of building construction materials or structural framing members provide obstruction or difficult support means, hanger rods shall be used in association with horizontal sections of steel support channels, in an approved manner.

N. All work shall be installed in a rigid and satisfactory manner and shall be supported by bar hangers in frame construction or shall be fastened directly with wood screws on wood, bolts with expansion shields on concrete or brick toggle bolts on hollow masonry units, and machine screws or welded threaded studs on metal. Threaded studs of the proper type and holding capacity driven in by a power charge and provided with lock washers and nuts are acceptable for mounting of equipment on solid concrete walls or slabs.

O. Obtain written permission from the General Contractor allowing use of power activated charges. Use only properly trained and licensed operators.

P. Do not use power charge driven supports for any work that is to be hung from a horizontal surface without written permission from the Architect.

Q. Preset inserts of the proper type and holding capacity shall be used in overhead slab construction wherever possible.

R. Provide lateral supports for work to prevent excessive movement during a seismic event using rods, braces or galvanized or stainless steel cables.

S. Pendants, supports or hanging rods longer than 12 inches (300mm) shall be laterally braced.

T. Where installed in damp, wet and areas requiring wash down, all surface mounted panels, boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 00 10 "Identification for Electrical Systems."

1. Confirm labeling scheme with the Owner prior to final labeling.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Provide preprinted or computer-printed type labels with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cable Labels: Use flexible vinyl or polyester that flexes as cables are bent.

3.8 CABLE SUPPORTS

A. Provide strain relief hardware for backbone cables at each floor level as they pass from one floor to the next.

B. Provide hook and loop (Velcro) cable wraps at all panels, equipment racks and cabinets. Cable ties are specifically prohibited.

C. Cable ties for horizontal cables shall be secured with minimum required compression in order to secure the cables properly without impeding the signal transmission rating (geometry) of the cable. Hook and loop (Velcro) cable wraps may be used in lieu of cable ties for copper cables only. Cable-ties are specifically prohibited for fiber optic cables.

D. When pathways are not provided or specified, provide J-Hook supports from the building structure as required for cable runs to the cable drop location. Maximum distance between supports shall be five feet (1 500mm) depending on the structural elements of the building. Maximum number of cables per support shall be thirty. Provide additional supports as required when cable quantities exceed thirty and to maintain required bending radius of cables. Cables installed exposed or in areas subject to abuse (below 10 feet (3m) above finished floor) or in accessible areas shall be installed in conduit.

E. All cables shall be supported directly from building structure. Under no circumstance shall cable be installed using cross bracing, plumbing/sprinkler pipes, ceiling systems or any other system that is not a specifically approved method to independently support cables. Cables shall not be allowed to rest on ceiling tiles, duct work, piping, etc. Supports shall be provided as required in order for cables to avoid contact with any other building system. Bundle cables in groups by Room.

3.9 CABLE PROTECTION

A. Provide bushings in all metal studs and the like where cables will pass through. Bushings shall be of two piece construction with one piece inserted through the opening and the second piece locking it into place. Single piece bushings with locking tabs or friction fit are specifically prohibited.

B. Cables to be installed in existing enclosed open bays or furred spaces where conduit stubs are not provided shall be protected from chafing or any damage. The Installer shall verify that the warranty shall not be violated before installing any cabling in these locations.

C. Provide cutting, coring, sleeves and bushings and seal as required at all penetrations.

D. Fiber optic backbone cables shall be installed in inner duct.

E. Cables damaged during installation shall not be repaired. They shall be completely replaced with new cable.

3.10 INSTALLATION

A. All cabling shall be installed in conduit where indicated on plans, or shall be installed open using other methods, approved by architect, such as J-Hooks.

1. Install wiring, per manufacturers recommendations. Use UL listed plenum cable in environmental air spaces including plenum ceilings.

B. All wiring shall be new and concealed in pipe where exposed.

C. All conduits and raceways shall have pull strings remaining after cable is pulled.

D. Impedance and Level Matching:

1. Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

E. Control Circuit Wiring:

1. Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
2. Make installation in strict accordance with approved manufacturer's drawings and instructions.
3. The Installer shall provide necessary transient protection on the AC power feed, all station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.

F. Weatherproofing:

1. Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

G. Typical Layouts and requirements of the specified systems:

1. Typical layout:

   a. Equipment racks and cabinets
   b. Backbone cabling
   c. Headend equipment

2. Typical layout of telecommunications equipment racks and cabinets.

   a. Each equipment rack and cabinet shall contain the following equipment:

      1) Fiber optic patch panel
      2) Fiber optic cable management
      3) Surge protector power strip
      4) Patch panels - Horizontal distribution
      5) Horizontal distribution cable management
      6) Vertical cable management
      7) Patch cords

   b. Provide space for the installation of network electronics equipment in the equipment racks.
   c. Furnish and install horizontal cable management between each patch panel (fiber optics, Hub distribution, Horizontal distribution, and telephone distribution).
   d. Furnish and install horizontal distribution patch panels in each wire center with sufficient ports to terminate all modular jacks shown on the drawings plus twenty percent spares. The exact number of modular jacks and horizontal distribution patch panels shall be obtained from the drawings.
   e. Furnish and install all equipment racks and cabinets required to support the aforementioned equipment.
   f. Grounding bars shall be installed under SECTION 26 00 10. Furnish and install the required grounding to ensure that all of the aforementioned equipment is grounded and bonded.

3. Headend

a. Final terminations from IDC cross connect block panels to telephone equipment and PBX by -Telephone Company and Equipment Installer. Coordinate with Telephone Company and Equipment Installer for final terminations.
b. Final terminations from the IDC cross connect block panels to the headend equipment shall be provided by the headend equipment installer.
c. Coordinate with the headend equipment installer and the electrical contractor for:

1) The installation of all the IDC cross connect block panels at the headend equipment. Installation shall be neat in appearance.
2) The final terminations at the headend.

3.11 TRAINING

A. As a minimum, training sessions shall consist of the following:

1. General project information and review shall be by the General Foreman or Superintendent of the Trade.
2. Specific system training shall be by a Factory Trained Representative.
3. Provide a complete review of the project and systems including, but not limited to, the following:

a. In a classroom environment review each Record Drawing (use of typicals is acceptable).
b. Note equipment layouts, locations and control points.
c. Review each system.
d. Review system design operation and philosophy.
e. Review alarms and necessary responses.
f. Review standard troubleshooting techniques for each system.
g. Review areas served by equipment.
h. Identify color codes used.
i. Review features and special functions.
j. Review maintenance requirements.
k. Review operation and maintenance manuals.
l. Respond to questions (record questions and answers).

4. After classroom training, walk the entire project, review each equipment room and typical locations. Explain equipment and proper operation.

B. During the instruction period the Owner and Maintenance Manual shall be used and explained.

C. The Owner and Maintenance Manual material shall be bound in 3-ring binders and indexed. On the edge of the binder provide a clear see-through plastic holder with a typed card indicating the Project name, the Architect's name, the installer's name and the Volume number (e.g., Vol. No. 1 of 2).

D. Provide name, address and telephone number of the manufacturer's representative and Service Company for all items supplied so that the source of replacement parts and service can be readily obtained.

1. Include copies of manufacturers and installer's warranties and maintenance contracts and performance bonds properly executed and signed by an authorized representative.

2. Include copies of all test reports and certifications.

E. Providers of the Broadband Video Distribution System shall provide training as part of their package. This comprehensive training plan shall addresses the following areas:

1. Training, providers of the Broadband Video Distribution System shall provide (4) hours of training as part of their package, this comprehensive training plan shall address the following areas:

a. System Orientation for all involved staff members.
b. Small group hands-on training sessions for all media center staff focusing on system-wide hardware and troubleshooting.
c. Small group hands-on software training sessions for all media center staff.

3.12 ACCEPTANCE DEMONSTRATIONS

A. Systems installed under this Section shall be demonstrated to the Owner and Architect. Demonstrations are in addition to necessary testing and training sessions. Notify all parties at least 7 days prior to the scheduled demonstration. Schedule demonstrations, in cooperation with and at times convenient to all parties, so as to not disturb ongoing activities.

B. Systems shall be tested prior to the demonstrations and each system shall be fully operational and tested prior to arranging the Acceptance Demonstration. Final payments will be withheld until a satisfactory demonstration is provided for all systems indicated or requested.

C. If the demonstration is not totally complete, performing all functions, features and connections or interfaces with other systems, or if there is a failure during the demonstration, additional demonstrations shall be arranged. Provide and pay for all costs, labor and expenses incurred for all attendees for each additional demonstration required for acceptance and demonstration of complete system operation.

D. Demonstrations shall be scheduled in ample time to complete all activities prior to final acceptance and Owner occupancy. Demonstrations shall take place at least 30 days prior to the scheduled project completion date and 30 days prior to owner’s use and occupancy.

E. As a minimum, provide demonstrations for systems indicated under "Work Included" under Part One of the Specifications. Provide demonstrations of additional systems as requested by the Owner, or Architect.

3.13 PROJECT OWNER COORDINATION

A. Prior to Substantial Completion of the project and in ample time to address and resolve any coordination issues, request and arrange meetings between the Owner, Owner's Vendors and Consultants, Architect and General Contractor to discuss the Scope of Work for each system being provided and the interface required for a fully functional and operational system upon project completion. Initial meetings shall be scheduled three months prior to the scheduled Substantial Completion date or as soon as Submittals are submitted and reviewed for projects with shorter schedules.

B. At these meetings the required interface with the Owner shall be reviewed, requests for information required to complete programming or for coordination shall be presented and system operation and philosophy shall be discussed.

C. Additional meetings shall be held as requested by any party so that all issues are resolved and with the goal and intent being that all systems are fully operational and functional upon project Substantial Completion and that the responsibility for all components required is clearly established.

3.14 CLEANING UP

A. Upon completion of all work, and testing, thoroughly inspect all exposed portions of the installation and completely remove all exposed labels, markings, and foreign material.

B. The interior of all boxes and cabinets shall be left clean; exposed surfaces shall be cleaned and plated surfaces polished.

C. Repair damage to finish surfaces resulting from work under this Section.

D. Remove material and equipment from areas of work and storage areas.

E. All equipment shall be clean from dirt, dust, and fingerprints prior to final acceptance.

F. Touch up all damaged pre-finished equipment using materials and methods recommended by the Manufacturer.

3.15 PROJECT CLOSEOUT

A. Provide close out submittals as required herein and in SECTION 01 78 00 - CLOSEOUT SUBMITTALS including the following close out submittals.

1. Operation and Maintenance Manuals
2. Record Drawings.
3. Test Reports.
4. Extra Materials.

B. Obtain written receipts of acceptance close out submittals submitted. Receipts shall specifically detail what is being delivered (description, quantity and specification section) and shall be dated and signed by firm delivering materials and by the Owner's Representative.

C. Telecommunications:

1. Provide fifteen (15 percent) spare patch cables and line cord for each cable length provided.
2. Provide record drawings indicating actual cable routing and cable terminations and all required identifiers. Provide copy mounted in each telecommunications closet and the main cross connect.
3. All sketches, drawings, and charts herein are for the purpose of providing for specifications in a simplified format. Errors and omissions in such does not relive the Contractor of the responsibility for providing a fully complete, secure and properly operating integrated instructional technology network system suitable for the intended use. Bidders must obtain a complete set of Project Drawings and Specifications to determine the full scope of work. In case of conflict the Project Drawings and Specifications shall prevail.

D. Construction Waste Management

E. Comply with Division 01 requirements for construction waste management and recycling.

END OF SECTION

SECTION 27 53 19
EMERGENCY RESPONDER RADIO SIGNAL AMPLIFICATION SYSTEM (BDA SYSTEM)
(PART OF SECTION 26 00 10)

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SECTION 27 53 19
EMERGENCY RESPONDER RADIO SIGNAL AMPLIFICATION SYSTEM (BDA SYSTEM)
(PART OF SECTION 26 00 10)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS –SUB-SUB BID REQUIRED

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

B. Examine all other sections of the specifications for requirements that affect work of this section whether or not such work is specifically mentioned in this section.

C. Coordinate work with that of all other trades affecting, or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. SUB-SUB-BID REQUIRING A PARAGRAPH “E” LISTING on the FORM FOR SUB-BID required per M.G.L. Chapter 149 Section 44A to 44L, as amended to date. The Electrical Subcontractor will be responsible for all related building preparation and coordination as required, see specification for additional Paragraph “E” Listing requirements of the BDA System SubContractor, and coordination of responsibilities.

E. Section 27 53 19 EMERGENCY RESPONDER RADIO SIGNAL AMPLIFICATION SYSTEM (BDA SYSTEM) shall be a Filed Sub-Sub Bid of Section 26 00 10 ELECTRICAL, requiring a Paragraph “E” Listing on the FORM FOR SUB-BID.

1.2 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 01 Section “Summary.”

1.3 SUMMARY

A. This specification describes the criteria for deploying an Emergency Responder Radio Signal Amplification System (BDA System). The BDA components specified in this document include: Bi-Directional Amplifiers (BDA), Donor Antennas, Coverage Antennas, Coax Cable, Coax Connectors, Splitters, Combiners and Couplers. These devices shall be used as part of a system, by the BDA integrator, experienced with designing projects for in-building, public safety, 2-way radio systems.

B. Provide pre-test to determine coverage.

C. Related Sections include the following:

1. Division 27, Section 270000 COMMUNICATIONS.

1.4 ABBREVIATIONS AND ACRONYMS

A. ACG: Automatic Gain Control

B. AHJ: Authority Having Jurisdiction

C. ATP: Acceptance Test Plan

D. BDA: Bi-Direction Amplifier

E. BOM: Bill-of-Material

F. DAS: Distributed Antenna System

G. EBS: Educational Broadband Service

H. ESMR: Enhanced Specialized Mobile Radio

I. FCC: Federal Communications Commission

J. GUI: Graphical User Interface

K. LMR: Land Mobile Radio

L. MTBF: Mean Time Between Failure

M. NFPA: National Fire Protection Association

N. NMS: Network Management System

O. PSN: Public Safety Network

P. RoF: Radio-over-Fiber

Q. RSL: Received Signal Level

R. SMR: Specialized Mobile Radio

S. SMS: Short Message Service

T. SNIR: Signal-to-Noise Interference Ratio

U. SOW: Statement of Work

V. VSWR: Voltage Standing Wave Ratio

1.5 DEFINITIONS

A. Acceptance: Expressed approval by the AHJ and owners representative

1.6 GENERAL DESCRIPTION

A. The building shall be both pre and post tested for Fire and Police departments radio signal strength. A test shall be scheduled with the Fire and Police Departments. Any expense incurred by the test shall be the responsibility of the BDA System SubContractor.

B. A site survey to determine the RF signal strength on or near the building grounds to determine the level of amplification necessary to provide clear and reliable radio communications over 95% of the overall area inside the building will be required, and 100% of critical areas as defined in the code is required.

C. The Fire and Police Departments radio test shall check the signal reception in several locations on the floor area. Signal strength shall be for clear reception throughout the building utilizing the type of hand held radio unit that is used by the Fire and Police Department. Quantity of test locations shall be determined and conducted by the local department representative. Each floor of the building shall be divided into a grid of approximately twenty (20) equal areas. A maximum of one (1) area will be allowed to fail the test per floor. A spot located approximately in the center of a grid area will be selected for the test. Once the spot has been selected, prospecting for a better spot within the grid area will not be permitted. Field strength testing instruments are to be recently calibrated (1 year) and of the frequency selective type incorporating a flexible antenna similar to the ones used on the hand held transceivers.

D. Required Signal Levels:

1. Signal strength shall be for clear reception throughout the building utilizing hand held radio units of the type(s), which are used by the Fire/Police Department. Signal strength testing shall follow TSB-88 standards using delivered audio quality measurements (DAQ).
2. A minimum signal strength of –95 dBm (DAQ4) shall be available on over 95% of the floor area required to be covered when transmitted from the fire department.
3. A minimum signal strength of –95 dBm (DAQ4) shall be received at the fire department system from over 95% of the floor area required to be covered.

E. Required Broadcasting Frequency:

1. Frequency to be compatible with Fire, Police Department.
2. The building owner will be responsible for keeping the operational frequencies of the BDA compatible with the Fire and Police Departments radio system.

F. It is the responsibility of the BDA System SubContractor to coordinate with the Town and provide the required Police and Fire frequencies. Frequencies include Police, Fire.

G. Emergency Responder Radio Signal Amplification System (BDA System)

1. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local fire department and other agencies and authorities having jurisdiction. System users shall receive and transmit radio broadcasts from their portable radio units within the building. This shall be accomplished utilizing the following components:

a. Bi-Directional Amplifiers (Signal Boosters)
b. Plenum rated Coaxial Cable
c. Antennas
d. Cable taps
e. Connectors
f. Power dividers
g. Other components and interconnecting circuitry as required.

2. The system shall comply with the requirements UL2524 In-Building 2-Way Emergency Radio Communication Enhancement systems, NFPA 72 2013 Edition, NFPA 1221 2016 Edition and IFC 2015, as referenced.
3. The entire system shall meet the requirements of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).
4. The work in this section shall include the responsibility for all permit requirements with the AHJ. Where filings require engineer's signature, documents shall be submitted for his or her review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.
5. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner
6. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included
7. The in-building emergency radio communication enhancement system shall use a UL2524 Listed, NFPA 72, NFPA 1221 and IFC 2018 compliant signal booster or approved equal.

1.7 DESIGN REQUIREMENTS

A. In-building radio signal amplification systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.

B. Critical Areas such as emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.

C. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.

1. The In-building emergency radio communication enhancement systems must provide the following signal strengths:

    a. Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
    b. Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.
    c. OR As otherwise required by the AHJ

2. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.
3. An approved manufacturer or a qualified and approved vendor shall supply, test and determine locations of components which are required for proper operation as well as to supply, install, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.
4. Design may include iBwave software-simulated radio propagation modeling with heat maps showing predicted signal coverage levels within the building. The iBWave design shall be done by iBWave certified personnel.
5. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.

6. The system design shall be based on the Radio Solutions, Inc (Norwell, MA) line of Public Safety Signal Boosters UL2524, NFPA 72, NFPA 1221, IFC and FCC certified to establish standards of quality for materials and performance. The naming of a specific manufacturer or a catalog number does not waiver any requirement or performance of individual components described in the specifications.
7. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.
8. Survivability from attack by fire shall meet requirements of NFPA 72, NFPA 1221, IFC or as required by the local jurisdiction.
9. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.
10. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions

PART 2 - PRODUCTS

2.1 TECHNICAL SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

A. The system specified shall be based upon Radio Solutions, Inc (Norwell, MA) line of Public Safety UL2524 Listed and NFPA72, NFPA 1221, IFC compliant signal boosters

B. The signal booster shall be a Class B Public Safety type as designated by the FCC or as required by the AHJ.

C. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA 72, NFPA 1221 and IFC. The signal booster shall have both the primary and the secondary power supplies within a waterproof, type-4 approved enclosure.

D. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.

E. The signal booster shall be pre-set by the equipment manufacturer for the frequencies specified by the AHJ. Field tuning of RF filters and duplexers is not allowed.

F. UHF and VHF signal boosters shall be band selective type with a maximum 3dB channel bandwidth of 200KHz (Fc +/- 100KHz) per band. Non-selective wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.

G. Signal Boosters shall have oscillation suppression circuitry to protect the public safety radio system in case of system malfunction or other causes. The oscillation suppression circuit shall not disable the system operation. Systems that automatically disable the signal booster upon oscillation detection shall not be allowed.

H. Signal Boosters shall have uplink noise suppression function to eliminate uplink noise while in standby (i.e. no radio transmission from within a building). Systems that produce any measurable level of uplink noise while in standby shall not be allowed.

I. Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 30dB range. System gain shall be set and documented at the time of the final system test.

J. Maximum Propagation delay of the signal booster system shall be the lesser of 14μs (microseconds) or as specified by AHJ.

K. The signal booster system shall include built-in automatic supervision of malfunctions of the signal booster and battery system as per NFPA 1221 NFPA 72 and IFC. Non-OEM equipment add-ons and modifications to comply with this specification shall not be allowed.

L. A dedicated supervised monitoring panel shall be provided within the emergency command center next to the fire alarm panel / annunciator or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

1. Normal AC power
2. Signal booster trouble
3. Antenna Failure
4. Loss of normal AC power
5. Failure of battery charger
6. Low battery capacity

M. The vendor shall verify the system monitoring requirements and the required annunciator location with the AHJ prior to system installation. System monitoring shall be fully compliant with the AHJ requirements.

N. Non-OEM External filters, duplexers, power supplies or other non-OEM additions or modifications of the original equipment shall not be allowed.

O. All signal booster components shall be contained in a type-4 approved and listed waterproof enclosure. All enclosures shall be painted red with external labeling as required by the AHJ.

2.2 INSTALLATION REQUIREMENTS

A. Installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code NFPA-70, NFPA-72, NFPA 1221, IFC and / or as required by the local AHJ.

B. At least 2 independent and reliable power supplies shall be provided as specified in NFPA 72, NFPA 1221 and IFC.

C. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA-70 National Electrical Code, NFPA 72 and NFPA 1221 2016 edition.

D. The signal booster shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall power on automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a waterproof Type-4 approved

enclosure. Batteries shall be enclosed in a separate, vented Type-3R or Type-4 approved enclosure. External UPS (Uninterruptable Power Supplies) are not acceptable.

E. The signal booster shall be designed to allow continued operation in adverse environmental conditions, such as high temperatures in the event heat from a nearby fire, water spray, voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) are not acceptable, unless required for FCC regulatory or safety compliance. It is the purpose of this specification to assure the maximum possible level of communications to public safety personnel depending upon the signal booster, even to the extent of damaging the signal booster, as long as some communications benefit can be provided during the emergency.

F. External UPS (Uninterruptable Power Supplies) are not acceptable

G. The power supply system design shall be such that neither the failure of the normal power source, the transfer to an emergency source, nor the re-transfer to the normal source shall cause an interruption or change in system status.

H. The amplifier shall be housed in a room or other suitable space as approved by the Engineer or Architect, or where specifically shown on the drawing.

I. Radiating cable, if used, shall be run without conduit. All other cable can be run in conduit if required for mechanical protection of the cable, or where specified by the electrical engineer.

J. RF Coaxial Cable shall be a fire-resistant, low-smoke type, U.L. classified as plenum. The classification shall be clearly marked on the outer surface of the cable regular intervals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The BDA System SubContractor shall install the BDA in accordance with the integrator’s instructions and recommendations.

B. Installation shall include the delivery, unloading, setting in place, fastening to walls, floors, ceiling, or other structures and where required, penetration fire-stop, interconnecting wiring of the system components, equipment alignment and adjustments, and all other work whether or not expressly required herein which is necessary to result in complete operational system.

C. All installation practices shall be in accordance with, but not limited to, these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements and recommendations of National, State, and Local Authorities having jurisdiction. All distributed antenna cables shall be installed such that the cables are straight as possible.

D. During the installation, and up to the date of final acceptance, the integrator shall be under obligation to protect his finished and unfinished work against damage and loss. In the event of such damage or loss, he shall replace or repair such work at no cost to the owner.

E. All equipment shall be properly mounted on equipment racks or walls and secured in place. Wall mounted equipment shall be mounted over a ½ in. plywood securely attached to the wall.

F. Cables shall be properly supported with dedicated hangers or brackets. Cable trays shall be used only if they are dedicated low voltage trays and only with approval from the owner.

G. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three.

H. All boxes, equipment, etc. shall be secured plumb, level and square.

I. In the installation of equipment and cable, consideration shall be given to operational efficiency and overall aesthetic factors. Antennas shall be centered and in-line with other ceiling mounted devices

J. All cables, regardless of length, shall be marked with cable markers reading “Public Safety Radio”, at regular intervals but not less than every 30 ft. There shall be no unmarked cables at any place in the system. In addition, markings codes at each end of the cables and patch panels shall correspond to codes shown on drawings and/or run sheets.

K. All cables the integrator installs must be handled in accordance with the manufacturers guidelines. Transmission line cables have minimum bending radius specifications that shall be followed. In the event a cable is kinked or bent excessively during installation that section of cable cannot be used, even if subsequently straightened. The damaged area of the cable shall be removed and a new section installed using correct splice methods. Ultimately the cable must pass the testing and meet the manufacturers requirements

L. Radio communications cabling shall not be grouped with electrical cabling. It can only share sleeves and raceways with other low voltage data and communications cables.

M. Connection between cables and other antenna components shall use N-Type premium connectors. No splicing is permitted.

N. All power dividers shall be securely mounted in place by bolting the mount to a solid surface or securing each by suspension on the cables within 4 inches of each connector termination at the power divider. The transmission lines connecting to the device shall be routed in the shortest possible path.

3.2 GROUNDING PROCEDURE

A. In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, the following grounding procedures shall be adhered to:

B. System Ground: A signal primary “system ground” shall be established for the system. All grounding conductors in that area shall connect to this primary system ground. The system ground shall consist of a copper bar of sufficient size to accommodate all secondary ground conductors. An extension of the ground shall connect to the buildings lightning protection system per the direction of the on-site electrical engineer.

C. A copper conductor, having a maximum of 0.1 Ohms total resistance, shall connect the primary system ground bar to the primary system ground ring.

D. Secondary system grounding conductors shall be provided from all racks, radio consoles, and undergrounded radio equipment in each area, to the primary system grounding point for the area. Each of these grounding conductors shall have a maximum of 0.1 Ohms total resistance.

E. Under no conditions shall the AC neutral conductor, either in the power panel or in receptacle outlets, be used for a BDA system ground.

F. Radio cable Shields: All radio cable shields shall be grounded at both ends.

G. General: Because of the great number of possible variations in grounding systems, it shall be the responsibility of the installer to follow good engineering practice, as outlined above, and to deviate from these practices only when necessary to minimize crosstalk and to maximize signal to- noise ratios and reduce interference in the radio systems.

3.3 CABLE AND CONDUIT

A. Note the following circuitry requirements:

1. Conduit intended for use with the firefighter's communication bi-directional radio amplifier system shall be steel electric metallic tubing (EMT), except as follows:

    a. It shall be galvanized steel intermediate conduit where mounted within 8 ft.-0 in. of the floor in mechanical spaces or otherwise exposed to mechanical damage, or where intended for embedment in concrete.
    b. It shall be galvanized steel intermediate conduit if local authorities prohibit use of EMT.
    c. It shall be rigid galvanized steel conduit for the power supply to the central equipment and to all outlying equipment cabinets requiring a 120-volt or 120/208- volt supply.

2. Where wires and cables are permitted to be run without conduit, they shall be independently supported from the building structure or ceiling suspension systems at intervals not exceeding four feet on center, utilizing cable supports specifically approved for the purpose. Wires and cables shall not rest on or depend on support from suspended ceiling media (tiles, lath, plaster, as well as splines, runners or bars in the plane of the ceiling), nor shall they be supported from pipes, ducts or conduits. Bundling and/or supporting ties shall be of a type suitable for sue in a ceiling air handling plenum regardless of whether or not installed in a plenum.
3. Cables shall be tagged or labeled at each termination point and in each intermediate junction box, pull box or cabinet through which they pass, as well as intervals not exceeding 50 feet on centers where cables are run without conduit.
4. Comply with applicable building and electrical code requirements for locating and routing circuitry, for installing circuitry, and for fire stopping.
5. The covers of all dedicated junction, pull boxes shall be painted red and labeled "Fire Dept. Radio System". Junction and pull boxes will not be shared with other systems.
6. Cables other than radiating coaxial cables shall be run in conduit where indicated by the Engineer. Where not indicated, cable shall be installed per manufacturer's recommendation. Conduit shall be electric metallic or threaded conduit subject to the restrictions specified elsewhere for light and power circuitry.
7. Radiating coaxial cables shall be run without conduit. Where installed in a plenum type ceiling cable insulation shall be of a fire-resistant low-smoke producing type, with a minimum rating of CATVR. This classification shall be clearly marked on the outer surface of the cable at regular intervals.

8. All Riser Cables and Cable to Donor Antenna shall be UL listed 2 hour rated Coaxial cable.

3.4 ACCEPTANCE TESTING

A. Acceptance and Test Procedures

1. Acceptance testing for an in-building radio system is required upon completion of installation.
2. The coverage testing shall be done in accordance with NFPA 72, National Fire Alarm and Signaling Code, 2013 edition, and as required by the local AHJ
3. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.
4. All test records along with system diagrams, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project.

END OF SECTION

SECTION 310000

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:
1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.
2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

C. Soil erosion and sedimentation controls shall be provided in accordance with the “Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers, and Municipal Officials” prepared by Franklin, Hampden, Hampshire Conservation Districts, reprint dated May 2003.

1.3 SUMMARY

A. This Section includes all excavation including, but not limited to, the following:

1. Excavating and backfilling for demolition of buildings and structures.
2. Excavating and backfilling for utility trenches.
3. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
4. Geotextiles.

B. Related Sections include:

1. Section 315000 Excavation Support and Protection
2. Section 312319 Dewatering

1.4 SUBMITTALS

A. Geotextiles:

1. Technical properties including but not limited to tensile strength, puncture strength, mullen burst, elongation, equivalent opening, permittivity, and water flow rate.
2. Provide a 12-by-12-inch sample of geotextiles and the manufacturer’s recommended installation procedure.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with the following requirements indicated:

1. Gradation Test Results for each on-site and imported soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D6938 and ASTM D1557 for each on-site and imported soil material proposed for fill and backfill.
3. Each submittal shall include the intended use for the material with the appropriate specification section and material name corresponding to the Contract Documents to facilitate review.

C. Copies of permits obtained for excavations that are required by state and local governing authorities and local utility companies shall be submitted to the owner's representative.

1.5 SITE INFORMATION

A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.

B. Plans, surveys, measurements and dimensions, under which the work is to be performed, are believed to be correct to the best of the Engineer's knowledge, but the Contractor shall have examined them for himself during the bidding period, as no allowance will be made for any errors or inaccuracies that may be found herein.

C. Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that the Owner and Engineer will not be responsible for interpretations or conclusions drawn therefrom by the Contractor.

D. The Contractor may request to perform additional test borings and other explorations at no cost to the Owner.

E. It is the responsibility of the Contractor under this Contract to do the necessary excavation, filling, grading, and rough grading to bring the existing grades to subgrade and parallel to finished grades as specified herein and as shown on the Drawings for this Work. The Contractor shall visit the site prior to submitting a bid to become familiar with the extent of the work to be done under this Contract. The Contractor shall be responsible for determining the quantities of earth materials that must be imported or hauled off the site necessary to complete the work under this Section. All imported earth materials required to construct the project shall be included in the Contractor's base bid.

F. The Contractor is allowed to re-use excavated On-Site Ordinary Borrow as fill in accordance with this specification. All On-Site Ordinary Borrow used as backfill shall be compacted to the required percentage of maximum dry density included in Table 2 below.

1. The Contractor is made aware that On-Site Ordinary Borrow may contain large amounts of silt. Additional efforts required to reuse On-Site Ordinary Borrow are the responsibility of the Contractor and shall result in no additional expense to the Owner or a request for additional time for delays caused by its usage.
2. The Contractor agrees to use this material at his own risk and is responsible for any additional work required to install this material in accordance with the specifications.
3. If project delays will result from the additional time required to re-work On-Site Ordinary Borrow, placed as fill in accordance with the specifications, the Contractor shall remove material that does not meet the compaction requirements and provide imported fill meeting

the specifications. This imported material shall be provided at no additional expense to the Owner.

4. Any project delays resulting from additional time required to work this material are the responsibility of the Contractor.

G. The Contractor shall use suitable on-site soils and fill, and soil from off-site sources, as needed. Please note that not all on-site materials will be suitable for reuse, nor will all required material gradations be present on the site. Imported materials are anticipated for this project.

H. Contractor shall protect and adjust moisture condition of all on-site and imported materials for proper installation, compaction, and use. This includes covering, drying, and adding moisture as required to maintain suitable workability of the soil materials. Please note onsite and imported materials will not necessarily be encountered or delivered in a suitable condition as environmental factors prevalent at the time of construction will impact soil materials.

1.6 UNIT PRICES

A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the limits specified in PART 3 - EXECUTION.

B. Unit prices for rock excavation include all labor, equipment, and materials required for removal of rock and hauling of rock off-site. Unit prices for rock excavation also include all labor, equipment, and materials required for replacement of rock excavation with approved materials where the rock excavation extends beyond the specified excavation limits. Any excavation beyond the specified excavation limits must be approved by the Owner's representative prior to removal. Specified excavation limits for rock are specified in Section 3.4 ROCK EXCAVATION.

1.7 DEFINITIONS

A. Backfill: Soil material used for fill and 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.

B. Base Course: Course placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil for use as fill or backfill.

E. Boulder: A soil particle with a minimum dimension of 12 inches.

F. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated on the Drawings.

1. Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner's Representative. Additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Bulk Excavation: Excavation more than 6 feet in width and more than 10 feet in length for the installation of utilities, foundations, and footings.

3. Trench Excavation: Excavation 6 feet in width or less for the installation of utilities, foundations, and footings
4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner's Representative. Unauthorized excavation, as well as remedial work directed by Owner's Representative, shall be without additional compensation.

H. Fill: Soil materials used to raise existing grades.

I. Imported Material: Material obtained by the Contractor from sources off the site.

J. Influence Area: The area within planes sloped downward and outward at an angle of 60 degrees from the horizontal from (a) 1 foot outside the outermost edge at the base of foundations or slabs; or (b) 1 foot outside the outermost edge at the surface of roadways or shoulder; or (c) 0.5 foot outside the exterior edge at the spring line of pipes and culverts.

K. Optimum Moisture Content: Determined by the ASTM standard specified to determine the maximum dry density for relative compaction.

L. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Owner's Representative.

M. Relative Density: As defined by ASTM D4253 or D4254.

N. Rock: Material in beds, ledges, unstratified masses, conglomerate deposits that cannot be removed, in the opinion of the Engineer, without systematic drilling, ram hammering, blasting, or ripping. Weathered Rock that can be removed by an excavator without hammering or other mechanical means shall not meet the definition of rock.

Rock also includes boulders of rock material that exceed 2 cu. yd. for bulk excavation or 1 cu. yd. diameter for footing, trench, and pit excavation.

1. Bulk Rock Excavation: Rock encountered within bulk excavation as defined above.
2. Trench Rock Excavation: Rock encountered within trench excavation as defined above.

O. 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.

P. Subbase Course: Course placed between the subgrade and base course for asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or asphalt walk.

Q. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

R. 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 non-soil materials.

S. Unsuitable Soils: Existing soils that, in the opinion of the Engineer and Owner's Representative, are unsuitable to remain in their existing location that are deposited outside the excavation limits. This does not include topsoil, subsoil, and silty-sand materials.

1. Anticipated unsuitable soils: Unsuitable soils identified in the geotechnical report, drawings, specifications, test pit logs, or boring logs provided as part of the project manual.
2. Unanticipated unsuitable soils: Unsuitable soils not identified in either the geotechnical report, test pits, or boring logs provided as part of the project manual.

T. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

U. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters. Well-graded is used to define a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.8 IMPORTED MATERIAL ACCEPTANCE

A. All imported earth materials specified in this section are subject to the following requirements:

1. Materials imported to the site by the Contractor for on-site use shall not contain oil and/or hazardous materials.
2. All tests necessary for the Contractor to locate acceptable sources of imported material shall be made by the Contractor. Certification that the material conforms to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory shall be submitted to the Engineer for approval at least 5 calendar days before the material is required for use. All material samples shall be a minimum of 40 pounds and furnished by the Contractor at the Contractor's sole expense. Samples shall be representative and be clearly marked to show the source of the material and the intended use on the project. Sampling of the material source shall be done by the Contractor in accordance with ASTM D75. Tentative acceptance of the material shall be based on an inspection of the source by the Engineer and/or the certified test results submitted by the Contractor to the Engineer at the Engineer's discretion. No imported materials shall be delivered to the site until the proposed source and the Engineer has tentatively accepted materials tests in writing. Final acceptance will be based on Quality Control and Quality Assurance tests made on samples of material taken from the completed and compacted course.
3. Gradation tests by the Contractor shall be made on samples taken at the place of production prior to shipment. Samples of the finished product for gradation testing shall be taken as specified in 3.16 FIELD QUALITY CONTROL, or more often as directed by the Owner's Representative if variation in gradation is occurring, or if the material appears to depart from the Specifications. Test results shall be forwarded to the Engineer within 48 hours of testing.
4. If tests conducted by the Contractor or the Engineer, indicate that the material does not meet Specification requirements; material placement will be terminated until corrective measures are taken. Material that does not conform to the Specification requirements and is placed in the work shall be removed and replaced at the Contractor's sole expense. Retesting of material that does not meet specification requirements shall be performed at the Contractor's sole expense.

1.9 QUALITY ASSURANCE

A. Employ a qualified surveyor, registered with the State of Massachusetts as a Professional Land Surveyor, as required for all layout and to establish grades for the work being performed.

B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 543 shall be hired to provide required testing of earthwork materials at the Contractor's Expense.

C. All temporary shoring and bracing shall be designed, detailed, and stamped by a Professional Engineer registered in the State of Massachusetts. Refer to SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

D. Pre-excavation Conference: Conduct conference at Project site prior to the start of construction. Date and time to be specified by the Owner's Representative.

1.10 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Owner in no less than two weeks in advance of proposed utility interruptions in writing. Renotify 72 hours in advance of proposed utility interruptions.
   a. Notifications should be made to the Owner's Representative.
   b. Do not proceed with utility interruptions without Owner's written permission.
   c. All power shutdowns shall be coordinated with the Owner.
2. Contact "Dig Safe" at 1-888-Dig Safe to verify locations of existing underground utilities in areas of proposed excavation prior to commencing any excavation effort.

B. Demolish and completely remove from site existing underground utilities indicated to be removed on the Drawings. Coordinate with utility companies to shut off services if lines are active.

1.11 EXCAVATION SAFETY

A. The Contractor shall be solely responsible for making all excavations in a safe manner. Contractor shall comply with all Local and State OSHA requirements.

B. Provide appropriate measures to attain a stable base, retain excavation side slopes and prevent earth slides to ensure that persons working in or near the excavation are protected.

1.12 LAYOUTS AND GRADES

A. All line and grade work not presently established at the site shall be laid out by a survey team under the supervision of a Registered Land Surveyor or Professional Engineer employed by the Contractor in accordance with Drawings and Specifications. The Contractor shall supply all additional layout and grade control as necessary to properly implement and construct the work. The Contractor shall establish permanent benchmarks and replace as directed any which are destroyed or disturbed.

B. The words "finished grades" as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas outside of the building shall be given uniform slopes between points for which finished grades are indicated or between such points and existing established grades.

1.13 TOLERANCES

A. All material limits shall be constructed within a vertical tolerance of 0.1 foot and a horizontal tolerance of 1 foot except where dimensions or grades are shown or specified as minimum. All

grading shall be performed to maintain slopes and drainage as shown. No reverse slopes will be permitted.

1.14 DRAINAGE

A. The Contractor shall control the grading in areas under construction on the site so that the surface of the ground will properly slope to prevent accumulation of water in excavated areas and adjacent properties.

B. The Contractor shall excavate interceptor swales and ditches where necessary prior to the start of major earthmoving operations to ensure minimal erosion and to keep areas as free from surface water as possible.

C. Should surface, rain, or ground water be encountered during the operations, the Contractor shall furnish and operate pumps or other equipment, and provide all necessary piping to keep all excavations clear of water at all times and shall be responsible for any damage to work or adjacent properties for such water. All piping exposed above ground surface for this use, shall be properly covered to allow foot traffic and vehicles to pass without obstruction.

D. Presence of ground water in soil will not constitute a condition for which an increase in the contract price may be made. Under no circumstances place concrete fill, lay piping, or install appurtenances in excavation containing free water. Keep utility trenches free of water until pipe joint material has hardened and backfilled to prevent flotation.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: The Contractor may reuse excavated on-site material for fill and backfilling where the material excavated is satisfactory and conforms with the below specified gradation requirements. The Contractor is to provide imported soil materials with satisfactory properties conforming with the below specified gradation requirements when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soils being free of rock or gravel larger than 3 inches in any dimension, debris, broken pavement, waste, frozen materials, vegetation, and other deleterious matter and conform to the criteria listed below:

C. Gradations of satisfactory soils are as shown in the Table below:

TABLE 1 - SOIL GRADATIONS					
Sieve Size	Sand Gravel Fill	Granular Fill	1-1/2 inch Crushed Stone	3/4 inch Crushed Stone	Coarse Sand
6-inch*	-	100	-	-	-
3-inch*	100	60-100	-	-	-
2-inch	-	-	100	-	-
1 ½-inch*	-	-	95-100	-	-
1-inch	-	-	35-70	100	-
¾-inch	70-100	-	0-25	90-100	-
½-inch	50-85	50-85	-	10-50	-
⅜-inch	-	45-80	-	0-20	100
No. 4	40-75	40-75	-	0-5	85-100
No. 10	30-60		-	-	20-50
No. 40	10-35	0-45	-	-	0-15
No. 100	5-20**	-	-	-	-
No. 200	0-8	0-10	<1	<1	-

* The maximum recommended stone size is three inches where placed as base course below slabs and pavement; elsewhere, maximum stone size shall be 2/3 of the loose lift thickness.
** The amount passing through the No. 100 sieve should be between 40 and 7 percent of the amount passing through the No. 40 sieve.

1. Ordinary Borrow shall be imported or excavated onsite material free of roots, sod, rubbish, debris, frozen materials, broken pavement, or other deleterious or organic matter, and conform to the following requirements.
   a. Imported Ordinary Borrow shall conform to the specified gradation of Granular Fill in Table 1.
   b. Onsite Ordinary Borrow shall conform to the specified gradation of Granular Fill in Table 1, but may contain no more than 15-percent by weight passing the No. 200 sieve. Onsite Ordinary Borrow shall not be placed as foundation wall backfill, as pavement base or subbase courses, as retaining wall backfill, or locations where free-draining backfill are required.
   c. Stones from excavated onsite material retained on a 3-inch sieve, less than 6-inches in diameter, and not exceeding two-thirds of the thickness of the horizontal layers placed after compaction can be placed for construction. Materials meeting these criteria shall not be included in the analysis for gradation. Materials exceeding this size shall not be placed in backfill below paved areas.
2. Subbase Material shall be free of rock or gravel larger than 3 inches in any dimension, debris, broken pavement, waste, frozen materials, vegetation, and other deleterious matter and conform to the gradation for Granular Fill in Table 1 within this specification.
3. Base Course shall be material free of rock or gravel larger than 3 inches in any dimension, debris, broken pavement, waste, frozen materials, vegetation, and other deleterious matter and conform to the gradation for Sand Gravel Fill in Table 1 above.
4. Riprap shall conform to MA Standard M2.02.0.
5. Filter stone shall conform to the gradation for ¾” Crushed Stone in Table 1 above.
6. Drainage Stone or Crushed Stone or 1 ½” Crushed Stone shall be imported material conforming to the gradation for 1 ½” Crushed Stone in Table 1 and having a maximum percentage loss of 12 percent as determined by the sodium sulfate test, AASHTO T104, and comply to the gradation provided in the table above.
7. Sand Gravel Bedding and Granular Fill Bedding shall conform to the Sand Gravel Fill and Granular Fill gradations, respectively, specified above except that 100% by weight must pass the 1 ½” sieve.
8. Gravel Borrow shall conform to the Sand Gravel Fill Gradation in the Table 1 above.
9. Refer to the Geotechnical Report for fill material requirements below the structure.

D. Unsatisfactory Soils are defined as soils not conforming to the satisfactory soils criteria unless otherwise approved by the Engineer.

2.2 GEOTEXTILES

A. Permanent Turf Reinforcement Mat: Provide North American Green SC250 permanent turf reinforcement mat or approved equivalent. The permanent turf reinforcement matting shall meet the following minimum properties per the Erosion Control Technology Council Type 5A and Federal Highway Administration's FP-03 Section 713.18.

Test	Method	Nonwoven (1)
Performance Test Unvegetated Shear Stress (lb/ft^2)	ASTM D-6460	2.0 min
Performance Test Vegetated Shear Stress (lb/ft^2)	ASTM D-6460	6.0 min
Seedling Emergence (%)	ASTM D-7322	250 min
Tensile Strength (lb/ft)	ASTM D-6818	150 min
Material Mass / Unit Area (oz/yd^2)	ASTM D-6566	8.0 min
Thickness (in)	ASTM D-6525	0.25 min
UV Stability (% @ 500 hrs)	ASTM D-4355	80

B. Filter Fabric: Non-woven geotextile shall be nonwoven and needle punched pervious sheets of polyester, polyethylene, nylon, or polypropylene filaments formed into a uniform pattern conforming to the MIRAFI 140N or approved equivalent. The geotextile shall have minimum properties as stated in the following table, when measured in accordance with the referenced standards.

Test	Method	Nonwoven (1)
Grab Tensile Strength (lbs)	ASTM D-4632	120
Puncture Strength (lbs)	Modified ASTM D-3787 Using 5/16-inch flat tipped rod	65 min
Mullen Burst (lbs/in^2)	ASTM D-3786	225 min
Elongation at Required Strength (%)	ASTM D-4632	50 min
Equivalent Opening (US Standard Sieve)	ASTM D-4751	70-100
Permittivity (sec-1)	ASTM D-4491 with 60 mm Falling Head	1.7 min
Water Flow Rate (gal/min/ft^2) at 50 mm Constant Head	(2)	80 –120

(1) All numerical values represent minimum/maximum average roll valves (i.e., the average of minimum test results on any roll in a lot should meet or exceed the minimum specified values).
(2) Water flow rate in gal/min/ft^2 shall be determined by multiplying permittivity in sec^{-1} as determined by ASTM D-4491 by a conversion factor of 74.

PART 3 - EXECUTION

3.1 PREPARATION

A. Furnish, install, and maintain shoring, sheeting, bracing, and sloping necessary to support the sides of earth and rock excavations, and to keep and prevent any movement which may damage adjacent structures, pavements, and utilities, damage or delay the work, or endanger life and health. Furnish, install, and maintain shoring, sheeting, bracing, and sloping as required by OSHA and other applicable government regulations and agencies.

B. All temporary shoring and bracing shall be designed, detailed, and stamped by a Professional Engineer registered in the State of Massachusetts.

C. Provide excavation support and protection in accordance with SECTION 31 50 00 EXCAVATION SUPPORT AND PROTECTION.

D. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent building area and walkways.

E. The use of onsite, excavated material may require stockpiling to allow the material to dry prior to placement. Provide erosion-control measures as specified in the drawings and as required by the Owner's Representative to prevent erosion of piles during wet weather periods.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. The Geotechnical Report prepared for this project indicates that groundwater may be present within the limits of excavation. The Contractor is made aware of this condition and shall include dewatering within his Lump Sum Bid.

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, specified in SECTION 31 23 19 DEWATERING, to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required at no additional expense to the Owner.

3.3 WORK IN FREEZING WEATHER

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit.

B. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of a day's operation. Prior to terminating operations for the day, the final layer of fill, after compaction, shall be rolled with a smooth-wheeled roller to eliminate ridges of soil left by tractors, trucks and compaction equipment.

C. The Contractor shall not place a layer of compacted fill on snow, ice, or soil that was permitted to freeze prior to compaction. Removal of these unsatisfactory materials will be required as directed by the Owner's Representative.

D. Do not excavate to full indicated depth when freezing temperatures may be expected, unless work can be completed to subgrade or piping can be installed and backfilled the same day. Protect the excavation from frost if placing of concrete or piping is delayed.

E. The Contractor shall keep the operations under this Contract clear and free of accumulation of snow within the limits of Contract Lines as required to carry out the work.

3.4 ROCK EXCAVATION

A. General

1. Rock excavation includes the removal of rock to the lines and grades shown on the plans and as specified within this Section and the disposal of the Rock off site by legal methods.

2. The Contractor shall obtain all necessary permit and licenses and pay all fees at no additional cost to the Owner.
3. All rock excavation shall be included within the original Contract Sum based upon the quantities provided in PART 4 - MEASUREMENT AND PAYMENT. Payment for rock excavation shall be adjusted in accordance with 4.1B.1 Quantities and Payment of Rock Excavation.
4. Unit prices for rock excavation include all labor, equipment, and materials required for removal of rock and hauling of rock off-site. Unit prices for rock excavation also include all labor, equipment, and materials required for replacement of rock excavation with approved materials where the rock excavation extends beyond the specified excavation limits. Any excavation beyond the specified excavation limits must be approved by the Owner's Representative prior to removal. Specified excavation limits for rock are specified in 3.4 ROCK EXCAVATION.
5. Prior to excavation, all rock quantities, bulk or trench, shall be reported to and verified by the Owner's Representative. A copy of all transport slips for rock removal from the site shall be provided to the Owner's Representative.
6. Rock capable of removal through standard excavation procedures shall be removed from the excavation, measured by the Contractor, and verified by the Owner's Representative.
7. The dimensions and quantity of the uncovered rock in place and the rock removed from the trench shall be measured by a Licensed Land Surveyor registered in the State of Massachusetts at the Contractor's expense. All survey information shall be supplied to the Owner's Representative for verification of the quantity. Survey information shall include the existing rock surface topography, the removed rock surface topography and the rock removal limits as specified herein.
8. If a change in the work occurs, which includes the excavation of additional rock outside the original contract limits, the Contractor shall uncover all rock to be removed. Upon uncovering rock in excavations that cannot be removed by standard excavation measures, the Contractor shall expose all faces of rock in the area that requires excavation and notify the Owner. The dimensions and quantity of the rock in place and the rock removed from the trench shall be measured by a Licensed Land Surveyor registered in the State of Massachusetts at the Contractor's expense. All survey information shall be supplied to the Owner's Representative for verification of the quantity.
9. Rock shall be removed by mechanical means and methods.

B. Rock Removal Limits

1. The Contractor shall remove rock to elevations, which will allow the installation of all foundations, footings, utilities, structures, trees and plantings, shown on the drawings.
2. The Contractor shall remove rock to a minimum of 30 inches below finished grade in paved areas and a minimum of 24 inches below finished grade in landscaped areas.
3. Around proposed utilities, the Contractor shall remove rock to the lines and subgrade elevations indicated on drawings and as dictated within this specification. The Contractor shall remove sufficient rock to permit the installation of permanent construction without exceeding 6 inches beneath pipe in trench, and the greater of 24 inches wider than pipe or 36 inches wide.

C. Rock Excavation for the Installation of Structures

1. Boulders and bedrock encountered during the site preparation should be removed from the building area. Any boulder or bedrock located within the building area should be removed to a depth of at least 12 inches below the foundation elevation. Voids that result from boulder removal should be backfilled with compacted Granular Fill.
2. Bedrock excavated for the building footings and slabs should be over excavated to allow for the placement of a compacted 12-inch Sand Gravel Fill cushion below the foundations and slabs placed in horizontal lifts with a maximum loose lift thickness of 12 inches. The cushion material should extend a minimum of 2 feet beyond the horizontal limits of the

foundations or slab. Care should be taken when removing rock adjacent to the existing structure to prevent undermining and disturbance of the footing.

D. Rock Excavation for the Removal of Utilities and Structures

1. Remove rock directly above and to the sides of piped utilities and structures proposed for removal without exceeding the following dimensions:
   a. 12 inches outside of concrete structures, walls, and footings.
   b. 12 inches from either edge of piped utility and 6 inches below piped utility
   c. 6 inches outside of edge of concrete cast against grade.
   d. 6 inches beneath bottom of concrete pads or slabs on grade.
2. Upon uncovering rock within a trench that cannot be removed by standard excavation measures, the Contractor shall expose all faces of rock within the trench and notify the Owner. The dimensions of the rock in place shall be measured by survey instrument by a Licensed Land Surveyor at the Contractor's expense and verified by the Owner's Representative.
3. Rock capable of removal through standard excavation procedures shall be removed from the trench, measured by the Contractor, and verified by the Owner's Representative.

3.5 EXCAVATION, GENERAL

A. Excavate to subgrade elevations. Material to be excavated will be classified as earth or rock. Do not excavate rock until it has been classified and quantified by the Contractor's land surveyor, and verified by the Owner's Representative

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

B. All topsoil and unsuitable or excess materials shall be stripped from areas of new construction or regrading. Materials suitable for reuse shall be stored in locations and approved by the Owner's Representative that will not interfere with construction operations.

C. Existing topsoil shall be stripped before any underlying excavating is begun.

D. All excess and unsuitable materials shall be legally disposed of off-site by the Contractor.

3.6 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

B. All unsuitable and fill materials shall be removed from the proposed building area to a limit defined by a 1-horizontal to 1-vertical slope extending downward and outward from two feet outside the edges of the building footing to firm undisturbed glacial till or bedrock. Cobbles and boulders greater than 6-inches in diameter encountered within these areas shall be removed to a depth of at least 12 inches below the bottom of footings. Voids that result from boulder excavations shall be backfilled with Sand Gravel Fill and compacted.

C. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grade to leave solid base to receive other work.

1. Based upon the characteristics of the on-site soils, the influence area below footings is defined as the area under footings extending from 2-feet outside the bottom edge of footing downward at an angle of 1 horizontal to 1 vertical.
2. Construction staging for the proposed building should be scheduled such that construction can proceed systematically and safely to avoid excavations within the influence areas of newly installed or existing footings. Where it will be necessary to excavate within influence areas, temporary support systems will be required to retain the surrounding soil and safely support structure loads. The scheduling process should consider the construction of structures within the project area and the construction of third-party structures that are adjacent to the project area.
3. The earth slope along the bottom of sloped footings (i.e., subgrade or bearing surface) should not exceed a slope of 2 horizontal and 1 vertical to allow a stable subgrade to be provided prior to the placing of concrete
4. In fill areas within the building footprint, the soil subgrade shall be surface compacted with a minimum of six passes of a vibratory roller having a drum weight of at least 10,000 pounds and a dynamic force of at least 20,000 pounds. In the event that subgrade soils within the building area become disturbed during construction, they should be over-excavated and replaced with one foot of compacted Sand Gravel Fill or six inches of ¾-inch Crushed Stone wrapped in filter fabric to stabilize the subgrade.
5. If the subgrade is wet, the Contractor shall over-excavate all footing excavations by 6 inches and place a working mat of ¾-inch Crushed Stone compacted to 95% wrapped in filter fabric (Mirafi 140N or approved equivalent). Stone shall extend 2 feet beyond the edge of the footing on all sides. This working mat shall be provided by the Contractor in wet conditions at no additional expense to the Owner.

D. Over-excavation by the Contractor, excavation below the proposed bottom of excavation, shall be backfilled in 6-inch lifts with compacted Sand Gravel Fill. In wet conditions, over excavation shall be backfilled in 6-inch lifts with 3/4-inch Crushed Stone and a layer of filter fabric approved by the Engineer and compacted to 95% until the proposed subgrade elevation is reached and the subgrade stabilized.

E. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.7 SUBGRADE INSPECTION

A. Notify Owner’s Representative when excavations have reached required subgrade.

B. If the Owner’s Representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Continue this process until the area has been proof-rolled 4-6 times. Limit vehicle speed to 3 mph.
2. Proof-roll with a vibratory roller with a static weight of no less than 10,000 lbs and a dynamic weight of 20,000 lbs.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Owner’s Representative, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner's Representative, without additional compensation.

3.8 EXCAVATION OF UNSUITABLE MATERIALS

A. The Contractor shall notify the Owner's Representative and Engineer when excavations uncover potential unsuitable materials.

B. Payment for all excavation and disposal of Unanticipated Unsuitable Soils within the limit of excavation shall be included as part of the original Contract Sum.

C. Excavation and disposal of Unanticipated Unsuitable Soils outside the limit of excavation shall be paid for in accordance with the Unit Prices included in PART 4 - MEASUREMENT AND PAYMENT of this specification.

1. Unit prices for unanticipated unsuitable soils excavation include all labor, equipment, and materials required for removal of unsuitable soils, hauling of unsuitable soils off-site, and disposal. Unit prices for unanticipated unsuitable soil also include all labor, equipment, and materials required for replacement of unsuitable soil excavation with approved materials. Any unanticipated unsuitable soil excavation must be approved by the Engineer and Owner's Representative prior to removal.
2. The dimensions and quantity of the Unanticipated Unsuitable Soils excavated shall be measured by a Professional Land Surveyor registered in the State of Massachusetts at the Contractor's expense. The Surveyor shall measure the elevations of the unsuitable materials prior to excavation and the surface topography following excavation. All survey information shall be supplied to the Owner's Representative for verification of the quantity. Survey information shall include the topography of the uncovered suitable soil surface prior to excavation and the topography of the final soil surface following excavation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.

B. Concrete required to fill unauthorized excavation shall be furnished and installed at the expense of the Contractor.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations in locations approved by the Owner. Do not store within drip line of remaining trees.

3.11 BACKFILL GENERAL

A. The contractor shall notify the Engineer and Owner's Representative a minimum of 2 days prior to backfilling utility trench to schedule inspection.

B. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation
2. Surveying locations of underground utilities for Record Documents
3. Testing and inspecting underground utilities
4. Removing concrete formwork
5. Removing trash and debris
6. Removing temporary shoring and bracing, and sheeting
7. Receiving approval from the respective Utility Company, and the Owners Representative following inspection

C. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact initial backfill conforming to the specified material requirements to the height specified on the Drawings over the utility pipe or conduit.

C. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Bedding material shall be placed and compacted in maximum 6” lifts.

F. All fill material (cobbles and boulders within the native deposits) in excess of 3-inches should be removed from the fill within 12-inches the utility to prevent damage to the utility during compaction.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
3. The Contractor shall furnish water for compaction. Water for compaction from sources other than potable sources shall be as approved by the Owner’s Representative.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

B. Compaction shall be completed with a vibratory roller having a static weight of 10,000 lbs and a dynamic weight of 20,000 lbs.

C. The Contractor shall use caution when compacting near existing utilities including electric and communications duct banks. Any damage to existing utilities or structures resulting from compaction operations shall be repaired at the expense of the Contractor.

D. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

E. Compact soil materials to not less than the following percentages of maximum dry density:

MINIMUM COMPACTION REQUIREMENTS TABLE	
Location	Percent of Maximum Dry Density [1]
Backfill below footings, within the building area and below slabs [2]	95
Backfill for foundation walls and frost walls	95
Backfill within pavement base and sub base layers	95
Backfill below pavement sub base layers	95
Around and above utilities within the building area	95
Around and above utilities in paved areas	95
Backfill behind retaining walls	95 [3]
Backfill within landscaped areas	92

[1] Maximum dry density as determined by the Modified Proctor test (ASTM D 1557)
[2] Building area is described as an area extending downward and outward from the outside edge of the footing at a 1.5H:1V slope.
[3] During compaction of fill placed behind retaining walls, care shall be taken so as to maintain uniform elevation along both sides within the embedded areas, and to not overstress the wall by applying too much compactive energy at the top of the wall.

3.15 SUBBASE AND BASE COURSE

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. Place subbase and base course on subgrade in 6-inch lifts and compact as specified.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: The Contractor shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed every 100 feet to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Owner's Representative.
2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
3. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
4. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specify tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Owner's Representative; reshape and recompact.

C. Where settling occurs remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by the Owner's Representative. If directed by the Owner, Contractor shall remove surplus satisfactory material from the site and dispose of in a legal manner.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

3.19 GEOTEXTILES

A. Install Geotextiles in accordance with Manufacturer's recommendations.

PART 4 - MEASUREMENT AND PAYMENT

4.1 GENERAL

A. Payment for earthwork as outlined in this Section or shown on the Drawings, including, but not limited to, all design, submittals, materials, labor, equipment, and all other incidentals associated with this work shall be included in the Contractor's Base Bid.

B. Unit prices for rock excavation include all labor, equipment, and materials required for removal of rock and hauling of rock off-site. Unit prices for rock excavation also include all labor, equipment, and materials required for replacement of rock excavation with approved materials where the rock excavation extends beyond the specified excavation limits. Any excavation beyond the specified excavation limits must be approved by the Owner's Representative prior to removal. Specified excavation limits for rock are specified in 3.4 ROCK EXCAVATION.
    a. The Contractor shall include in his base bid 10 **cubic yards of Bulk and Trench Rock** and its removal from site.
        1) If the total amount of trench rock exceeds the amount included in the Contract hereinabove, the Owner shall pay for the excess amount of trench rock at the Unit Price included on the bid form.
        2) If the total amount of trench rock is less than the amount included in the Contract hereinabove, the Contract sum will be decreased by the difference in trench rock multiplied by the Unit Price included on the bid form.

C. Unit prices for unanticipated unsuitable soils excavation include all labor, equipment, and materials required for removal of unsuitable soils, hauling of unsuitable soils off-site, and disposal. Unit prices for unanticipated unsuitable soil also include all labor, equipment, and materials required for replacement of unsuitable soil excavation with approved materials. Any unanticipated unsuitable soil excavation must be approved by the Owner's Representative prior to removal.

1. Quantities and Payment of Unanticipated Unsuitable Soil Conditions:
   a. If unanticipated unsuitable materials are encountered beyond the limits of excavation as specified on the Drawings and Specifications, the Contractor shall notify the Owner's Representative in writing. The Contractor shall carry excavation deeper and replace the excavated material with appropriate specified material or concrete as directed by the Owner's Representative or Geotechnical Engineer.
   b. Removal of topsoil, subsoil, and rock layer as specified in this specification will not be considered as unanticipated unsuitable soil conditions. Similarly, removal of these materials within paved areas as specified herein will not be considered unanticipated unsuitable soil conditions.
   c. Only changes in the work authorized in advance by the Owner's Representative in writing shall constitute an adjustment in Contract Price.
   d. Material that is too wet or too dry for compaction of the particular material in place as determined by the Owner's Representative or the Geotechnical Engineer and/or Soil Testing Company and is disturbed by the Contractor during construction operations so that proper compaction cannot be reached shall be removed and replaced with approved material as directed by the Owner's Representative or Geotechnical Engineer at no additional cost to the Owner.
   e. The Contractor shall follow a construction procedure, which permits visual identification of firm natural ground.
   f. The Contractor shall carry in the Base Bid **50 cubic yards for removal of Unanticipated Unsuitable Materials** and replacement with suitable compacted fill material in place, as directed herein. The Base Bid shall cover all costs related to such excavation, removal off site, and replacement with compacted fill of approved material, overhead, and profit. No amount other than the Unit Price provided by the Contractor will be paid by the Owner for excavation herein defined.
      1) If the total quantity of unanticipated unsuitable materials and its replacement with compacted fill exceeds the amount included in the Contract as listed above, the Owner shall pay the excess excavation and replacement at the unit price included on the bid form.
      2) If the total quantity of unanticipated unsuitable material and its replacement with compacted fill is less than the amount included in the contract as listed above, the contract sum will be decreased by the difference in excavation and its replacement multiplied by the unit price included on the bid form.

D. All quantities of unanticipated unsuitable soils and rock excavated are to be measured in place by a Professional Land Surveyor registered in Massachusetts as described above and verified by the Owner's Representative prior to removal.

E. The Contractor shall submit signed slips showing quantities of Unanticipated Unsuitable Soils and Rock removed from excavations at the end of each workday, with a total quantity mutually agreed upon. Slips shall be signed by the Owner's on-site representatives at the end of each day signifying that the quantities are accurate. The Owner has the right to inspect individual loads, slips and quantities as they arrive at or leave from the site and as they are weighed out at the stone quarry. These quantities are for reference only and will not be used to calculate payment with the unit prices above.

END OF SECTION

SECTION 311100

SITE PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:
   1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.
   2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

C. Soil erosion and sedimentation controls shall be provided in accordance with the “Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers, and Municipal Officials” prepared by Franklin, Hampden, Hampshire Conservation Districts, reprint dated May 2003.

1.3 SUMMARY

A. The work of this Section includes the following:

   1. Provisions for protection of all existing utilities from damage particularly at heavy construction vehicle crossings.
   2. Removal, disposal, capping or plugging of drainage, sewer, gas, steam, and water piping at the locations specified on the drawings.
   3. Removal and disposal of catch basins, manholes, cisterns, utility structures.
   4. Removal and disposal of steps, stairs, signs, and fence.
   5. Cleaning and maintenance of the site and stormwater management system.
   6. Site Clearing.
   7. Tree Protection.

B. Related Sections include the following:

   1. Section 310000 Earthwork
   2. Section 312319 Dewatering;
   3. Section 313200 Erosion and Sedimentation Control.

1.4 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 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.

1.5 MATERIAL OWNERSHIP

A. Unless noted otherwise, cleared materials shall become Contractor's property and shall be removed from Project site.

B. The Owner reserves the right to claim ownership over any materials removed from the site, including earthwork. The materials claimed by the Owner shall be stockpiled on the site as directed.

1.6 SUBMITTALS

A. Shop Drawings:

1. Submit drawings or details indicating proposed provisions for protection of existing gas line and utilities as the work requires. These utilities must be protected from damage particularly by heavy construction equipment driving over the top of them.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner, Owner’s Representative, and Architect not less than two weeks in advance of proposed utility interruptions in writing. Renotify in writing 72 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner’s written permission.
3. Underground utilities were compiled from available record plans and visible aboveground locations and are considered approximate only. Prior to commencing any excavation effort, the Contractor shall contact “Dig Safe” at 1-888-Dig Safe to verify locations of existing underground utilities in areas of proposed excavation.

B. The Contractor is responsible to schedule the work and determine any required temporary utility lines and connections required to keep the existing facilities in operation. The cost to furnish and install temporary utility lines and connections shall be included in the Contactor’s base bid.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with the Owner and utility companies to shut off services if lines are active.

D. Contractor shall not operate existing water gate valves and hydrants. Only utility company employees or designated personnel are authorized to operate Water System valves and hydrants.

E. All abandoned underground utilities shall be designated on as-built drawings by the Contractor of record and provided to the Owner and Engineer in AutoCAD electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.

F. Do not commence site operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor shall provide all materials and equipment in suitable and adequate quantity as required to accomplish the work shown and specified.

2.2 TREE PROTECTION MATERIALS

A. Fencing for tree protection, as designated, shall be new four-foot (4') orange snow fencing as manufactured by Resinet, www.resinetproducts.com. Stakes for snow fence shall be six foot (6') long, 13 gauge, powder coated steel, stamped metal drive stakes, commonly used to support snow fence. Stakes shall be located 5 ft. on center, maximum, at all corners and changes in direction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction. The Contractor shall employ a Professional Land Surveyor registered in the Commonwealth of Massachusetts to perform a benchmark and field verification survey prior to commencing work. The Contractor is responsible to provide horizontal and vertical layout of all proposed work.

1. Notify Owner and Owner’s Representative prior to commencing work if discrepancies are found.

B. Locate and clearly flag trees and vegetation to remain or to be relocated. Review trees with Owner and Landscape Architect prior to removal.

C. Protect existing site improvements to remain from damage during construction.

D. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 REMOVE AND DISPOSE SEWER, DRAINAGE, STEAM, AND OTHER GRAVITY UTILITY PIPING

A. All pipe or conduit designated to be removed shall be so-removed and legally disposed of off-site. Drain pipes or other pipes, ducts, etc., cut and deemed advisable to remain in the earth shall be plugged with concrete, except that metal drain pipes may be sealed with screw type plugs or caps. Drain pipes or other pipes that are cut for a new connection shall be temporarily capped and sealed water tight to prevent sediment or water from entering the utility.

B. The Contractor shall cooperate with the Owner and utility companies so that the demolition work may be performed in accordance with their regulations and with the approval of the Owner.

3.3 REMOVE AND DISPOSE WATER

A. Only utility company employees or designated personnel are authorized to operate Water System valves and hydrants.

B. Once valves are closed, pipe shall be cut and cleaned prior to being capped with a watertight heavy duty cap.

C. Cap shall be thoroughly cleaned of any dust, dirt or deposits prior to installation.

D. Install concrete thrust block as required. If the cap and thrust block will be later removed for a connection, install the thrust block to not damage the water main upstream of the cap.

3.4 REMOVE AND DISPOSE CONCRETE UTILITY STRUCTURES

A. All concrete utility structures designated to be removed shall be so-removed and legally disposed of off-site. The Contractor shall cooperate with the Owner and utility companies so that the demolition work may be performed in accordance with their regulations and with the approval of the Owner's Representative.

3.5 REMOVE AND DISPOSE GAS

A. All gas mains, services, valves, and appurtenances shall be removed and demolished in accordance with Eversource gas, the utility company, requirements. Contractor shall coordinate all work adjacent to gas with Eversource gas prior to commencing work.

3.6 REMOVE AND DISPOSE CONCRETE OR STONE FOUNDATION REMANTS

A. The Contractor shall excavate concrete or stone foundation remnants uncovered during excavation for proposed improvements. Remove and dispose concrete and stone foundation remnants in accordance with local and State requirements.

3.7 REMOVE AND DISPOSE FLEXIBLE PAVEMENT, CEMENT CONCRETE PAVEMENT, AND SAWCUTTING

A. Pavement edges shall be sawcut to a neat line using a saw approved for cutting through bituminous concrete or concrete materials.

B. Remove and dispose of bituminous concrete pavement as allowed by the State Standards Specifications.

C. Remove and dispose of cement concrete pavement as allowed by the State Standards Specifications.

3.8 REMOVE AND DISPOSE OF CURBING

A. Remove and discard existing curb in accordance with Section 580 of the State Standards.

3.9 DISPOSAL

A. Disposal: Remove surplus soil material, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property. Any potentially contaminated soil material encountered, as specified by the Commonwealth of Massachusetts Department of Environmental Protection rules and regulations shall be brought to an approved landfill or another appropriately licensed waste facility for legal disposal.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

3.10 CLEANING AND MAINTENANCE OF STORM DRAIN SYSTEM

A. The Contractor shall remove sediment and debris from the existing drainage system prior to commencing work.

B. During construction the Contractor shall be responsible to clean sediment and debris from the existing and recently installed drainage system.

C. Prior to project completion the complete drainage system shall be cleaned of all debris and sediment.

3.11 TREE PROTECTION

A. Trees: Trees as designated on the Contract Drawings to be protected shall be protected by the placement of a snow fence enclosure at the drip line of each tree as noted on the detail drawing. Snow fencing shall be supported with specified stakes at maximum five foot on center intervals and at all corners. Fence trees in accordance with the Drawings and as directed by the Owner's Representative.

B. Tree protection shall remain in place until directed for removal by the Owner's Representative.

C. Damage no trees to remain by burning, by pumping of water, by cutting of live roots or branches, or by any other means. No trees to be saved shall be used for crane stays, guys or other fastenings. Vehicles shall not be parked or be allowed to drive over root zones where damage may result to trees to be saved. Construction materials shall not be stored beneath trees to be saved. Excavation shall not take place within the tree's drip line unless approved by the Owner's Representative.

D. Contractor liability: The Contractor shall be liable for all damage and/or disturbance to existing trees not otherwise designated for removal. Actual charges for damage to plants shall be in accordance with the schedules defined herein, with assessed charges to be deducted from sums payable under the Construction Contract.

1. Damage which in the Owner's Representative's opinion can be remedied by corrective maintenance shall be repaired immediately. Only a certified Arborist shall undertake any tree work.
2. Trees irreparably damaged shall, at the Owner's Representative's discretion, be replaced by the Contractor with new trees of the same size and type as determined by the Owner's Representative.
3. In the event that replacement of damaged trees is infeasible, as determined by the Owner's Representative, the full replacement costs shall be assessed to the Contractor's account at a minimum value of one hundred and fifty dollars ($150.00) per caliper inch, or greater, in accordance with the "Guide for Plant Appraisal", authored by the Council of Tree and Landscape Appraisers,.
4. Damaged trees which require removal and/or replacement shall be removed according to the specification requirements for removals, including filling and repair of ground surface, with such costs to be borne by the Contractor in addition to assessed charges described herein.

E. Contractor shall be liable for all damage and/or disturbance to existing adjacent lands beyond the Limit of Work. Actual damage to these areas, caused by the Contractor, shall be repaired to the satisfaction of the Owner's Representative, at no additional cost to the Owner. Repairs may include pruning or removing damaged vegetation, replacement of damaged vegetation, restoration of the ground plane to its original condition, and any other work required to restore the

area to its original condition as depicted in the site photographs taken at the beginning of construction. The project will not be accepted until all repair work is complete.

3.12 SITE CLEARING

A. General: Remove trees, shrubs, grass and other vegetation, improvements, or obstructions, except for those indicated on the Contract Drawings to remain, interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated. Removal shall include digging out stumps in their entirety and grubbing roots to at least 30 inches below existing or proposed grades, whichever is deeper, as shown on the Contract Drawings.

B. Carefully and cleanly cut roots and branches of existing trees indicated to remain and be protected, where such roots and branches obstruct new construction. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.

C. Clearing shall consist of the felling and disposal of standing trees, and the removal and disposal of all brush, down timber, fences and rubbish. Trees, brush and down timber may be chipped and a portion of the chipped material shall be stockpiled on site in a location selected by the Architect and for dispersion into wooded areas in locations selected by Architect.

D. In all areas that are to be cleared, all brush, grass and other vegetation, except trees, shall be cut off flush with or below the original ground surface.

E. All lines and grade work required for this contract at the site shall be laid out by a registered land surveyor or Professional Engineer employed by the Contractor, in accordance with the Drawings and Specifications.

F. Prior to starting site clearing operations, stake out all roads, edges of parking areas, and other future paved areas as indicated, limits of cut and fill at the edges of these areas (it limits do not coincide) and areas of trees to be saved as noted on the Drawings.

G. Before any clearing is done, promptly upon completion of layout work, the Contractor shall arrange a conference on the site with the Architect to identify and mark trees and shrubs which are to remain. Adjustments to clearing lines shall be made at this time to save trees or other existing conditions on the edges of clearing lines. If necessary, minor grading adjustments shall be made to save these trees. Do no clearing without clear understanding of existing conditions to be preserved.

H. The owner shall be reimbursed should individual trees, shown on the drawings to be protected, become damaged during the course of the work. All expenses incurred shall be paid by the Contractor without additional cost to the Owner.

I. The owner shall be reimbursed should trees, which are beyond limits of clearing shown on the drawings or beyond limits of clearing approved by the Architect, be cleared or damaged and are part of larger, contiguous wooded areas.

J. These damaged trees shall be removed from the site, the stumps grubbed and the ground surface repaired. Costs for this removal shall be borne by the Contractor and not be included as part of the above schedule.

K. Fell trees in such a way as not to injure trees to be saved. Trees shall be cut three feet or less from existing grades. All brush or other material shall be cut flush to the ground. All material from clearing operations shall be chipped or cut into log lengths. All piles of chipped material (except those stockpiled for future inclusion in the work) and logs from clearing operations shall be removed from the site prior to or at the end of the clearing work.

L. Limits of clearing shall be those areas shown on the Drawings with modifications as herein specified. Removal of trees, shrubs and bushes outside these areas shall be done only as noted on Drawings or approved by the Architect.

M. No trees to be saved shall be used for crane stays, guys or other fastenings. Vehicles shall not be parked nor debris burned where damage may result to trees to be saved. Do not permit heavy equipment, materials or stockpiles within branch spread. Remove interfering branches without injury to trunks and cover scars with wound paint.

END OF SECTION

SECTION 312319

DEWATERIING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:
1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.
2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

C. Soil erosion and sedimentation controls shall be provided in accordance with the “Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers, and Municipal Officials” prepared by Franklin, Hampden, Hampshire Conservation Districts, reprint dated May 2003.

1.3 SUMMARY

A. The objective of this Section is to remove standing water from excavations when necessary to perform the work as specified and collect water which may enter the excavation during Contractor’s excavation activity.

B. Related Sections include the following:

1. Section 310000 – Earthwork.
2. Section 315000 – Excavation Support and Protection.

1.4 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.

B. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.

C. Prevent surface water from entering excavations by grading, dikes, or other means.

D. Accomplish dewatering without damaging existing buildings adjacent to excavation.

E. Remove dewatering system if no longer needed.

1.5 SUBMITTALS

A. Shop Drawings for Information:

1. For dewatering system. Show arrangement, locations, and details of dewatering locations; locations of erosion controls and dewatering basins.
2. Include a written report outlining control procedures to be adopted if dewatering problems arise.

B. Record drawings at Project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering.

C. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

1. At no time is discharge to be allowed to enter an existing drainage structure without sedimentation controls. Any damage caused by dewatering will be repaired in full to match existing conditions at the Contractor's expense.
2. At no time is discharge allowed to enter the existing sanitary sewer system.
3. At no time shall discharge be allowed to enter directly into the MassDOT rights-of-way.

1.7 SITE INFORMATION

A. Refer to Section 310000 for additional site information.

B. Make additional test borings and conduct other exploratory operations necessary for dewatering.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor shall provide any equipment and materials necessary for dewatering at the Contractor's own expense.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.

B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

C. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

D. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

E. Provide erosion controls in accordance with the Massachusetts Erosion and Sediment Control Handbook.

F. Dewatering basins capable of handling the flows directed to them shall be supplied whenever dewatering is required.

G. Control surface water and groundwater such that excavation to final grade is made in-the-dry, and bearing soils are maintained undisturbed, Contractor shall prevent softening, or instability of, or disturbance to, the subgrade due to water seepage.

H. Provide protection against flotation for all work.

I. The impact of anticipated subsurface soil/water conditions shall be considered when selecting methods of excavation and temporary dewatering and drainage systems. Type of dewatering system, spacing of dewatering units and other details of this work shall address site specific conditions.

J. Take all necessary measures to prevent damage to adjacent structures, utilities, property(ies).

K. Modify, redesign, and/or replace the dewatering system at no additional cost to the Owner, if design criteria are not continuously and effectively fulfilled.

L. Repair damage to adjacent structures, utilities, and properties resulting from the operation of the Contractor's dewatering and treatment system, at no additional cost to the Owner

3.2 INSTALLATION

A. Install dewatering system utilizing pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, utilities, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of drains, sewers, utilities and other excavations.

D. Collect precipitation or surface runoff in shallow ditches around the perimeter of the excavation, drain to sump and pump from the excavation to maintain in-the-dry conditions.

E. Dewatering and drainage operations shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the sub grade at the bottom of the excavation. If the sub grade becomes disturbed for any reason, the unsuitable sub grade material shall be removed and replaced with concrete, compacted granular fill, or other approved material to restore the bearing capacity of the subgrade to its original undisturbed condition.

F. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others.

G. Provide sumps, dewatering basins, sedimentation tanks, and other flow-control devices to avoid erosion and sedimentation.

H. Direct discharges to storm drains will be unacceptable unless proper sediment and siltation removal devices are installed prior to discharge to the storm water conveyance system.

I. Any discharge of water, generated from a dewatering operation, into wetlands or an open water body will not be permitted.

J. Ensure that such discharge does not lead to groundwater mounding or other conditions that are not in compliance with the Massachusetts Contingency Plan (310 CMR 40.0000) or the Massachusetts Groundwater Discharge Permit Program 314 CMR 5.00. If discharge is conducted in accordance with a Pretreatment Permit, Contractor is responsible for completing applicable laboratory analysis and maintaining compliance with all permit conditions. Contractor is also responsible for all consequences of non-compliance and/or permit violations. If discharge is completed through off-site disposal, the Contractor is responsible for completing all necessary laboratory analysis to ensure material is within the permit requirements of the accepting facility.

K. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

L. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

M. Damage including but not limited to erosion or sedimentation, resulting from untreated dewatering discharges shall be restored to meet or exceed the existing condition. All remedial work shall be completed in accordance with local and State Environmental Regulations and Requirements.

3.3 PROPERTY LOSES FROM REMOVAL OR DISTURBANCE OF GROUNDWATER

A. Any structure, including but not limited to embankments, buildings, streets, and utilities that become unstable or vulnerable to settlement due to removal or disturbance of groundwater will be supported immediately by the Contractor. Support shall include but not be limited to bracing, underpinning, or compaction grouting.

B. All loss or damage arising from removal or disturbance of groundwater, including but not limited to claims for subsidence and the loss of structure support, that may occur in the prosecution of the work shall be sustained and borne by the Contractor. If the Contractor needs to correct the damage resulting from his operations, the Owner may, 30 days after notifying the Contractor in writing, proceed to repair, rebuild or otherwise restore such damaged property as may be deemed necessary, and the cost thereof shall be deducted from compensation which may be or become due the Contractor under this Contract.

END OF SECTION

SECTION 313200

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:
   1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.
   2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

C. Soil erosion and sedimentation controls shall be provided in accordance with the “Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers, and Municipal Officials” prepared by Franklin, Hampden, Hampshire Conservation Districts, reprint dated May 2003.

1.3 SUMMARY

A. The work of this Section includes the following:

   1. Provision of temporary erosion and sediment controls and permanent site stabilization, specifically compost filter socks, baled hay erosion checks, temporary diversions, temporary sediment traps, and catch basin inlet protection as indicated on the drawings or as directed by the Owners Representative.
   2. Maintenance and cleaning of erosion and sedimentation controls specifically compost filter socks, baled hay erosion checks, temporary diversions, temporary sediment traps, and catch basin inlet protection as necessary or as directed by the Owner’s Representative.

B. Related Sections include the following:

   1. Section 31 00 00 Earthwork.
   2. Section 311100 Site Preparation;
   3. Section 312319 Dewatering;

1.4 DEFINITIONS

A. Cleaning: Cleaning consists of removing debris and accumulated sediment-laden deposits from the upstream side of perimeter controls, check dams, and temporary drainage protection and

from the bottom of temporary dewatering basins and stilling basins. All material so-removed shall be legally disposed of.

B. Compost Filter Sock: Three-dimensional tubular filtration device constructed by filling a mesh tube with a compost filter media.

C. Maintenance: Maintenance consists of repair and restoration to original configuration of damage sustained by erosion and pollution controls caused by “normal” rainfall events.

1.5 SUBMITTALS

A. Shop Drawings:

1. Product information depicting that the products furnished meet the project specifications.

B. Submit Storm Water Pollution Prevention Plan (SWPPP) prepared in accordance with the National Pollutant Discharge Elimination System (NPDES) Construction General Permit. Refer to Section 325000 Stormwater Pollution Prevention Plan for Contractor’s requirements to prepare and implement the SWPPP.

C. Submit one SWPPP to the North Reading Conservation Commission prior to commencement of work.

1.6 COMPLIANCE

A. All work shall be done in compliance with the provisions of all local, state and federal regulatory agencies. Failure to comply with these provisions shall constitute grounds for the Owner ordering work to cease until such provisions are met.

B. The Contractor shall comply with the requirements of the USEPA NPDES General Construction Permit and all other applicable requirements of governing authorities having jurisdiction. The Specifications and Drawings are not intended to be complete erosion and sediment control practices necessary to complete the work and comply with the NPDES Program requirements, but rather convey the intent to provide complete slope protection and erosion control for the adjacent properties.

C. If required, the Contractor shall meet with the regulatory agencies for clarification regarding requirements of the execution of, and compliance with, environmental protection programs. The Contractor shall familiarize itself with the nature of the work to be performed.

D. Refer to Section 325000 Stormwater Pollution Prevention Plan for Contractor’s requirements to prepare and implement the SWPPP.

E. Contractor shall prepare and implement sediment and erosion control plans as required for each phase of work.

F. Contractor shall be made aware and of and comply with the requirements stated in the Massachusetts Department of Environmental Protection – Order of Conditions

G. Contractor shall notify and coordinate with the North Reading Conservation Commission prior to commencement of any work.

H. Contractor shall monitor weather forecasts to ensure adequate erosion controls are provided for anticipated conditions.

1.7 SITE INFORMATION

A. Refer to Section 310000 for additional site information.

B. Do not commence operations which disturb the ground surface until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 EROSION AND SEDIMENTATION CONTROL MEASURES

A. Compost Filter Sock.

1. Materials shall be in accordance with AASHTO Designation: MP 9-06. Compost material shall meet applicable Federal and State Regulations.
2. For compost filter socks 18” or less in diameter, wooden stakes shall be 1 inch by 1 inch, at 10-foot intervals on center, and of a length that shall project into the soil 1 foot leaving 3 to 4 inches protruding above the filter sock.
3. For compost filter socks greater than 18” in diameter, wooden stakes shall be 2 inch by 2 inch, at 10-foot intervals on center, and of a length that shall project into the soil 1 foot leaving 3 to 4 inches protruding above the filter sock.

B. Temporary Turf Reinforcement Mat

1. Temporary turf reinforcement mats shall be North American Green Product S150 or approved equivalent.
2. Temporary turf reinforcement mat shall be degradable after 12 to 24 months
3. Provide a temporary turf reinforcement mat designed to stabilize a 3:1 slope or greater.

C. Filter Fabric

1. See Geotextiles in Division 2 Section 31 00 00 “Earthwork” for specification.

D. Temporary Seed

1. Provide temporary seeding per subsection M6.03.1 Temporary Seeding of the State Standards.

E. Temporary Sediment Traps, Swales, and Diversions

1. Refer to Section 310000 Earthwork for soil materials and excavation.
2. Provide temporary seeding.
3. Provide turf reinforcement mat as required to stabilize side slopes.

F. Construction Accesses

1. Construction Accesses shall be installed in accordance with the Project details.

PART 3 - EXECUTION

3.1 PROVISION OF COMPOST FILTER SOCKS

A. Trenching is not required, for typical installation; therefore, soil should not be disturbed upon installation. Compost filter socks shall be placed over the top of ground and wooden stakes shall be driven through the center of the filter socks to anchor them to the ground. To ensure optimum

performance, heavy vegetation shall be cut down or removed and extremely uneven surfaces shall be graded to ensure that the compost filter sock uniformly contacts the ground surface.

B. Compost filter socks may be vegetated by incorporating seed into the compost prior to placing it in the tube.

C. The ends of the compost filter sock shall be directed upslope, to prevent stormwater from running around the end of the sock.

3.2 PROVISION OF INLET PROTECTION

A. Install inlet protection device securely below catch basin rim in accordance with manufacturer's recommendations.

3.3 CONSTRUCTION ENTRANCE

A. Clean and maintain construction entrance to limit tracking of sediment from site.

B. Any sediment tracked from the site shall be immediately cleaned by the Contractor on the same work day.

3.4 TEMPORARY TURF REINFORCEMENT MAT

A. Install turf reinforcement mat on all exposed cut/fill slopes with a slope 3:1 or greater to protect against rainfall and wind erosion and hold moisture content to enhance vegetation growth in seed where shown in the plans.

B. Install erosion control lining in the required locations immediately after the areas has been seeded.

1. Place the erosion control lining over the seed mulch to fit against the contours of the area. It shall be applied without stretching, lie smoothly but loosely, and be free of wrinkles and bunches. Roll the material in place and in the direction of the flow of surface water. Anchor the up-grade end of the erosion lining in a narrow trench 6" deep. Firmly tamp the trench backfill in place.
2. In ditches and on slopes, provide check or junction slots at no greater than 50' intervals.
3. Where the erosion lining comes into contact with the edges of catch basins or other structures, place a tight fold in the edge of the material and bury it a minimum of 6" into the soil.
4. Install staples no more than 6" apart at all anchor, junction or check slots.
5. Where two lengths of erosion control lining are joined, the end of the upgrade strip shall overlap the downgrade by a minimum of 6" strip and the two strips shall be anchored together.

3.5 MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS

A. Remove all sediment impounded by the erosion and sediment control barrier and dispose of on-site in locations that will not erode. Repair erosion controls as required to maintain erosion and sediment within the limit of disturbance and protect resource areas.

B. Repair all erosion controls at substantial completion and get inspection and approval of the condition of the protection from the Owner's Representative.

3.6 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 the Drawings.

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.

D. Following stabilization of the site and the receipt of permission from the Owner’s Representative, the Contractor shall remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property. Any potentially contaminated soil material encountered, as specified by the Commonwealth of Massachusetts Department of Environmental Protection rules and regulations, shall be brought to an approved landfill or an appropriately licensed waste facility for legal disposal.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

3.8 PREPARATION

A. Restore damaged improvements to their original condition, as acceptable to Owner, at no additional cost.

3.9 TEMPORARY SEEDING

A. In accordance with Subsection M6.03.1 Temporary Seeding of the State Standards

END OF SECTION

SECTION 315000

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:
1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.
2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

1.3 SUMMARY

A. This Section includes temporary excavation support and protection systems.

B. Related Sections include the following:

1. Section 312319 - Dewatering.
2. Section 310000 - Earthwork.

1.4 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

B. The Contractor assumes all responsibility for the excavation support systems used. In the event of a failure, all resulting damages are the responsibility of the Contractor.

C. Vibration monitoring for excavation support systems will be performed by Subcontractor’s vibration consultant and monitoring firm. Vibration due to Subcontractor’s operations shall not exceed specified limits 1.04 E.

1.5 SUBMITTALS

A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.

1. Include Shop Drawings signed and sealed by a qualified Registered Professional Engineer licensed in the Commonwealth of Massachusetts.
2. Working drawings and details on the excavation support proposed by the Contractor shall be provided along with detailed calculations showing the design of the bracing and sheeting proposed also stamped by a Registered Professional Engineer licensed in the Commonwealth of Massachusetts.
3. Working Drawings and design calculations, at a minimum, shall indicate the following:
    a. Design criteria.
    b. Details, arrangement and method of assembly and disassembly of proposed system and sequence of construction.
    c. Connection details.
    d. Method of preloading the bracing.
    e. Full excavation depth.
    f. Loads on support system for various stages of excavation and bracing removal.
    g. Expected equipment loads.
    h. Maximum design load carried by various members of support system, and preload values.
    i. Depths below main excavation to which support system will be installed.
    j. Methods of resolving difficulties arising from misalignment of soldier piles or steel sheetpiling exposed during excavation, and criteria for implementing procedures.
    k. Design calculations, for various stages of excavation and bracing removal.
    l. Existing utility facilities. After checking locations by field investigations, revise drawings to show actual locations of facilities and excavation supports interference with proposed Work, and measures proposed to overcome such interferences.
    m. Manufacturer’s product data.
4. Design Computations: The Contractor shall also submit complete computations for the design of the sheeting and bracing system(s) proposed to be installed.
    a. The design shall be in accordance with sound engineering practice and modern, accepted principles of soil mechanics.
    b. The design shall include the effects of all surcharge which may be reasonably anticipated.
    c. The minimum factor of safety for each of the design conditions required to be considered shall be 1.50.

B. Qualification Data for Installer and Professional Engineer.

C. Submittal Review:

1. The design and layout will be reviewed by the Engineer as to type and suitability, providing that the arrangements presented by the Contractor are satisfactory, but such review will not relieve the Contractor of the sole responsibility for the adequacy of the system, nor shall it be construed as a guarantee that the Contractor's proposed equipment, materials and methods for sheeting and bracing will be adequate for the work required at the locations of and for the work required by this contract.

1.6 SITE INFORMATION

A. Refer to Section 310000 for additional site information.

B. The Contractor may make test borings and conduct other exploratory operations necessary for excavation support and protection.

C. Survey adjacent structures and improvements adjacent to the excavation support system to monitor settlement. Employ a qualified professional engineer or land surveyor to establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations during construction.

D. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Owner's Representative if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

1.7 QUALITY CONTROL

A. Provide in accordance with the requirement as specified in Division 1 Specification Sections.

B. Support of Excavation shall be of sufficient strength to safely sustain all loads from the sides of the excavations, together with all water pressure and reasonable surcharge.

C. The Contractor shall, at all times, be entirely responsible for the adequacy of sheeting and bracing used:

1. to permit the satisfactory and safe installation and construction of the work;
2. to provide adequate protection against damage to all existing utilities, structures, and completed portions of the work; and
3. to prevent injury to persons.

D. The Contractor shall control, and pitch, the grading to prevent water from running into the excavated areas of the structures, or to prevent damage to other structures or work already accomplished.

1. Welding Operations – in accordance with AWS D1.1

E. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring", and all other applicable laws, regulations, rules, and codes.

F. If required by the Owner or Owner's Representative, retain the services of an independent vibration consulting firm with the following in-house personnel to conduct the following vibration monitoring requirements:

1. Preparing, reviewing, and signing of monitoring plans and daily reports, and overseeing of the monitoring and interpretation of the vibration data shall be performed by personnel with the following qualifications:
   a. Be a Massachusetts Registered Professional Engineer.
   b. Have a minimum of five (5) years experience in the vibration consulting field.
   c. Have successfully completed at least five (5) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

G. Installation, monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:

1. Have at least three (3) years of experience in the operation of monitoring equipment proposed for use and interpretation of records produced by such equipment.

2. Have installed, operated, monitored and interpreted equipment and records on at least three (3) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

1.8 DESIGN CRITERIA

A. This design criteria applies where the Contractor is responsible for design of the excavation support:

1. Design the excavation support system in accordance with the earth pressures and other detailed criteria indicated.
2. Design the excavation support system to support the earth pressures, decking system and AASHTO HS20 traffic loads if any, utility loads, equipment and construction loads, and other surcharge loads to allow the safe and expeditious construction of the permanent structures without movement or settlement of the ground, and to prevent damage to, movement or settlement of, adjacent buildings, structures, or utilities.
3. Design sheet pile and soldier pile and lagging excavation support systems to penetrate to a depth below the bottom of excavation adequate to prevent lateral and vertical earth movement, and permit lowering of the indicated bottom of excavation at least two feet without any change in the support system as installed except for additional lagging and bracing for soldier pile and lagging systems.
4. Design the bracing system to furnish sufficient reaction against the side banks to maintain stability in such banks. Obtain such reaction by timely stressing to predetermined locations until the necessary reaction is produced against the banks, or by such other methods that may be necessary to prevent displacement of ground and movement of structures.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel:

1. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
2. Steel sheet piling – ASTM A328,: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

B. Lagging:

1. Timber Lagging: use sound, well-seasoned Douglas Fir of rectangular cross section, Grade 2 or better. Timber shall be stamped and certified ALOPB LP-22 by the American Preserves Bureau.
2. Moisture Content shall not exceed 20%.
3. Minimum fiber stress in bending perpendicular to the grain shall be 1200 psi.

C. Timber Sheeting:

1. Any species of wood sheets that will satisfactorily withstand all driving and construction stresses and the loads, to which the members will be subjected, may be used for sheeting and bracing.
2. Wood sheeting shall not be less than three (3) inches nominal thickness.
3. All timber sheeting and bracing shall be free from worm holes, windshakes, loose knots, decayed or unsound portions of other defects which might impair its strength or tightness.

D. Other Materials:

1. The Contractor shall provide all hardware and fastenings necessary to accomplish satisfactory installation of all sheeting and bracing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Sheeting and bracing shall be of sufficient strength to sustain all loads from the sides of the excavations, together with all water pressure and surcharge.

B. The Contractor shall be entirely responsible for adequacy of sheeting and bracing used, and shall take all precautions necessary to prevent movement of material along the sides of excavations, and to prevent the intrusion of water beyond that which his pumping or well point system can control.

C. Sheeting shall be permanently left in place where indicated or directed.

D. It is expressly understood and agreed that whenever sheeting and bracing is used, it shall not relieve the Contractor of the sole responsibility for any damages, delays, or injury due to installation or failure of the sheeting or bracing, or the settling of the backfill, the pipeline, or the adjacent ground.

3.2 TIMBER SHEETING

A. Sheeting shall be driven to sufficient depth below the deepest excavation level to maintain sufficient restraint of the adjacent soil and to prevent movement of the sheeting or excessive intrusion of groundwater.

B. If voids occur behind the sheeting, they shall be filled immediately with proper material from earth excavation or other sources to the satisfaction of the Engineer.

C. Withdrawal of sheeting shall be carefully performed to prevent movement of material along the sides of the backfilled excavations, to prevent damage to utilities, structures, or the work, and to avoid injury to persons.

D. Unless otherwise permitted, sheeting shall be withdrawn in lifts of not more than four (4) feet, and all voids shall be filled immediately with selected materials and thoroughly compacted.

3.3 STEEL SHEET PILING

A. Install in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, being tightly against original ground. Use vibratory pile driver to install sheeting to depth required for design. The equipment and methods of installation, cutting, and splicing shall conform to the approved Working Drawings.

B. Steel sheet piling located within a one to one slope from the bottom of the foundation element shall not be removed.

3.4 SOLDIER PILES AND LAGGING

A. Provide bored holes for soldier piles adequate to accommodate pile sections shown on approved Working Drawings. Extend holes to necessary depth below level of subgrade. When pre-boring is to occur within two feet of a utility, uncover utility and install a steel drill casing to a level at least six inches below bottom of utility prior to pre-boring.

B. Carry bottom of sheeting system to a depth below main excavation adequate to prevent lateral movement and to obtain adequate vertical support. In areas where additional excavation is required below main excavation subgrade, prevent movement of main excavation supports.

C. Encase soldier piles with 2500 psi concrete up to lowest point of excavation adjacent to pile location. Fill remainder of hole with lean concrete, completely encasing pile.

D. Use timber lagging secured in place to soldier piles.

E. Follow excavation closely with placement of lagging. Do not allow height of unlagged face of excavation to exceed five feet in rock and predominately clayey soils, or three feet in sandy soils. Extend lagging to final subgrade. Decrease height as required to prevent ground movement.

F. Do not permit height of unlagged face to exceed 15 inches if water flows from face of excavation, or if soil (of any type) in face moves towards excavation area. Decrease unlagged face height as required to prevent ground movement.

G. Carefully perform excavation for installation of lagging to minimize formation of voids. Separate lagging members only as necessary to permit packing behind them.

H. Pack behind lagging as installation progresses; establish tight contact between excavation face and lagging. Pack openings between lagging members with straw or other suitable material to allow free drainage of water without loss of soil or sand packing.

I. If unstable material is encountered during excavation, take suitable measures to contain unstable material in place and prevent ground displacement, which may cause damage.

J. Maintain sufficient quantity of material on hand for lagging, bracing and other operation for protection of Work and for use in case of accident or emergency.

3.5 SUPPORT SYSTEMS WITH INTERNAL BRACING

A. Use walers, struts, and rakers as necessary to provide internal support of excavation faces retained by soldier piles. Internal columns are unacceptable.

B. When walers are used, obtain tight bearing between wales and wall, and ample bearing area with starpack for load transfer.

C. Provide struts as indicated and intermediate bracing as needed to enable struts to carry maximum design load without distortion or buckling.

D. Provide diagonal bracing as needed for stability of system.

E. Include web stiffeners, plates or angles as needed to prevent rotation, crippling or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.

F. Install and maintain internal bracing support members in tight contact with each other and with surface being supported. Attach struts to wales using direct end bearing vertical plate (shimmed) connections at all levels.

G. Design internal bracing support members for maximum forces occurring during excavation or removal stages.

H. Preloading:

1. Preload internal bracing members, including struts, (except deck beams), shores and similar members, to 50 percent of design compression load occurring during excavation phase.
2. Use procedures that produce uniform loading on bracing members without inducing appreciable eccentricities or overstressing and distortion.
3. Make provisions for permanently fixing each member with steel shims or wedges welded into place.
4. Accomplish preloading by jacking supports in place against soldier piles or wales.
5. Do not use wooden wedges to preload bracing member.
6. Include in preloading system means to determine, within five percent, amount of preload induced into bracing members.

I. If decking beams are not required, or if decking beams are not designed to support excavation loads, install uppermost tier of bracing at vertical distances not more than eight feet below top of excavation.

J. Install tiers of internal bracing with a vertical distance between them and level of excavation below of not greater than 15 feet. Reduce maximum vertical distance to nine feet where ground movement and settlement shall be minimized to prevent damage, where indicated or as directed.

K. Excavate below point of support as indicated. Install bracing, and preload immediately after installation and before continuing excavation.

L. When removing struts, increase vertical spacing provided invert slab has been place for at least ten days and support system is adequate to support, safely, adjacent structures and works.

M. Vertical spacing of bracing may be increased when removing struts, provided support system is adequate to support adjacent structures and works.

3.6 REMOVAL OF SUPPORTING SYSTEM

A. When removing excavation support system, do not disturb or damage adjacent buildings structures, construction, or utility facilities. Fill voids immediately with lean concrete or with approved backfill compacted to the density as specified in Section 31 00 00, “Earthwork”.

B. Except as specified herein and below, remove sheeting system to a depth of at least six feet below the ground surface.

C. Remove material of supporting system from the Worksite immediately.

END OF SECTION

SECTION 32 12 16.10

ASPHALT PEDESTRIAN PAVING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The conditions and general requirements of the Contract, Division 0 and applicable parts of Division 1, apply to the work under this Section.

B. All references to products by manufacturer, trade name or performance Specifications bearing the connotation "or Approved Equal" shall be as determined by the Landscape Architect and the Owner, per MGL c. 30 s. 39M, part b, criteria 1.

1.2 DESCRIPTION OF WORK

A. Work Included: A. Provide all labor, equipment, implements and materials required to furnish, install, construct and perform all paving operations complete as shown on drawings and specified herein.

1. Bituminous Concrete for Pedestrian Walkways;

B. Related Work: A. Examine all other sections of the Specifications and all Drawings for the relationship of the work under this Section and the work of other trades. Cooperate with all trades and all departments and coordinate all work under this Section. The following related items are included under the Sections list below:

1. Section 02 41 00 – Demolition and Site Preparation
2. Section 03 30 00 – Cast-In-Place Concrete
3. Section 31 00 00 – Earthwork
4. Section 32 32 00 – Site Walls

1.3 DEFINITIONS

A. The following related items are included herein and shall mean:

1. S.S.H.B. – Standard Specifications for Highways and Bridges, the Commonwealth of Massachusetts, Dept. of Public Works, latest edition.
2. A.S.T.M. – American Society for Testing and Materials.
3. A.N.S.I. – American National Standards Institute
4. A.A.S.H.T.O. – American Association of State Highway and Transportation Officials.
5. E.P.A. – United States Environmental Protection Agency
6. MassDOT. Massachusetts Department of Transportation

1.4 JOB CONDITIONS:

A. Start of work under this Section shall constitute acceptance of the foundation conditions to which this work is to be applied. Any defects in work resulting from such conditions shall be corrected under this Section, at no extra cost to the Owner.

B. Maintain sub-base in satisfactory condition and properly drained until surface improvement is placed.

1.5 SUBMITTALS

A. Do not order materials or begin installation of work of this Section until Owner approval of submittals has been obtained.

B. Compaction tests are required on all bituminous concrete base surfaces on a 15’ grid interval or per Owner’s direction. At the Contractor’s expense, an independent testing agency must perform the work and submit the results directly to the Landscape Architect.

C. Separate Shop Drawings shall be submitted for each detail of all cast-in-place concrete edging, curbing, as shown on the Drawings.

1.6 QUALITY ASSURANCE

A. References

1. ASTM E 303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
2. ASTM D 2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
3. ASTM D 638-10 Standard Test Method for Tensile Properties of Plastics
4. ASTM D 3389 Abrasion Testing
5. ASTM C 33 Standard Specification for Concrete Aggregates
6. AASHTO M6 Standard Specification for Fine Aggregate for Hydraulic Cement Concrete
7. DIN 1835 Part 6- Permeability to Water
8. EPA Method 3052:1996.
9. MassDOT. Standard Specifications – Latest edition of the Standard Specifications for Highways, Bridges and Waterways, The Commonwealth of Massachusetts Department of Transportation, 1988 edition.

1.7 DELIVERY, STORAGE, AND HANDLING

1. Deliver products in original packaging, labeled with product identification, manufacturer, batch number, and shelf life.
2. Store products in a dry area with temperatures as required by product Manufacturers.
3. Handle products in accordance with manufacturer's printed recommendations.

1.8 PROTECTION

1. A. All existing items indicated to remain on the Drawings, including but not limited to furnishings, trees, or any installed improvements, shall be protected from any damage during paving. Any damaged materials shall be replaced at the expense of the Contractor.

PART 2 - PRODUCTS

2.1 BITUMINOUS CONCRETE PAVING

A. Pavement: Shall be bituminous concrete Class I-1 conforming to the Standard Specifications. The bituminous concrete shall be laid in two (2) courses with a minimum finished pavement depth after rolling of 4”.

B. Base Course: Shall consist of 2 1/2" minimum thickness. Composition of mixture shall conform to MHD Master Range for Dense Binder.

C. Wearing Course: Shall consist of 1 1/2" minimum thickness. Composition mixture shall conform to MHD Master Range for 3/8” Top Course.

PART 3 - EXECUTION

3.1 BITUMINOUS CONCRETE PAVING

A. Grades:

1. All grades in non-athletic-court pavement areas shall be established and maintained to a tolerance of 1/4" in 10'-0".
2. Within athletic court areas, the surface of the asphalt material should be level within 1/16” with use of a 10’ straight edge.

B. Apply two courses as shown on the drawings. Installation to comply with all standard and specifications set forth in the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

C. The asphalt material should be laid in 12’ wide strips, with the seams run in the same direction as the pitch.

D. The first layer shall be watered, to help locate and repair any standing water that may exist prior to the second layer installation.

E. Upon installation of the asphalt the asphalt should be rolled with a minimum 8 ton roller and no roller ridges should be seen upon completion.

3.2 GRADE STAKES

A. Install and maintain grade stakes, as directed. All subgrades must be approved before base course construction.

3.3 FINISH GRADES

A. The words "finish grades" as used herein mean the required final grade elevations.

3.4 AS-BUILT CONSTRUCTION TOLERANCES

A. A. Final inspection shall be conducted to verify conformance to the drawings after removal of excess aggregate. All pavements shall be finished to lines and levels to ensure positive drainage at all drainage outlets and channels.

B. The final surface elevations shall not deviate more than +/- 3/8 inch under a 10 ft long straight edge.

C. Lippage shall be no greater than 1/8-inch difference in height between adjacent pavers or surface materials.

D. Bond lines for the pavers shall be +/- 1/2-inch over a 50-foot string ling.

E. Verify the in-situ surface infiltration rate of the permeable pavement is a minimum of 100 in/hour using ASTM C1781.

END OF SECTION

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SECTION 321217

HOT MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:

1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.

2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

1.3 SUMMARY

A. This Section includes the following:

1. Hot Mix Asphalt paving.
2. Hot Mix Asphalt walkway paving.
3. Hot Mix Asphalt patching.
4. Curbing.

B. Related Sections include the following:

1. Section 310000 "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Section 320116 “Flexible Pavement Recycling” for recycling existing bituminous concrete pavement.
3. Section 321723 “Pavement Markings” for pavement marking paint.

1.4 DEFINITIONS

A. DOT: Massachusetts Department of Transportation

B. HMA: Hot Mix Asphalt

1.5 DESIGN REQUIREMENTS

A. Use all means necessary to protect bituminous concrete pavement materials before, ongoing, and after installation, and to protect the installed work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacements necessary as directed by the Owner's Representative at no additional expense to the Owner.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated include technical data, gradation, and composition of materials proposed.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Qualification Data: For manufacturer.

D. Material Test Reports: For each paving material.

E. Conformance Certificates: For each paving material, signed by manufacturers.

F. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international graphics symbol, spaces dedicated to people with disabilities.

G. In case of settlement or other defects in new or replaced pavements, the Contractor shall cut out, replace, restore or repair the damaged pavements at no additional expense to the Owner. This requirement shall remain in effect for 2 year after the acceptance of the work by the Owner. The pavement area to be replaced, repaired or restored, shall extend from edge of pavement to edge of pavement, a minimum of 20 feet on either side of the defect; final pavement course shall be feathered to provide a smooth finish detail.

1. The Contractor shall furnish a bond for the 2-year duration to the Owner insuring that the corrective repairs will be performed if necessary.

1.7 QUALITY ASSURANCE

A. Manufacturer shall be a paving-mix manufacturer registered with and approved by the Massachusetts Department of Transportation.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. Regulatory Requirements: Comply with the State Standards.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Conform to State Standards.

2.2 HOT MIX ASPHALT CONCRETE SURFACE COURSE

A. Hot Mix Asphalt Surface Course – Standard Top; conform to Section 450 or 460 as applicable and Section M3.11.00 of the State Standards.

2.3 HOT MIX ASPHALT CONCRETE BASE COURSE

A. Hot Mix Asphalt Base/Intermediate Course- Binder; conform to Section 450 or 460 as applicable and Section M3.11.00 of the State Standards.

2.4 TACK COAT

A. Conform to Asphalt Emulsion Tack Coat as specified in Section 460 and Section M3.11.06 of the State Standards.

2.5 SUB-BASE COURSE

A. Provide Sub-Base Course material as specified on the Drawings. Materials shall conform to Section 310000 – Earthwork.

2.6 SUBGRADE

A. Construct subgrade with Ordinary Borrow as specified in Section 310000 - Earthwork.

2.7 CURBING

A. Granite curbs shall be in accordance to MassDOT Standard Specifications M9.04.1 and installed in accordance to MassDOT Std. Spec. Section 500.

B. Precast concrete curbing shall conform to Subsection 501.63 and M4.02.14 of the State Standards.

C. Bituminous Berm shall conform to Hot Mix Asphalt Berm Type A in Section 501.64 of the State Standards.

D. Provide concrete curb lock on all curbing. Curb lock shall be 3,000 psi concrete.

2.8 COARSE AGGREGATE

A. ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

2.9 FINE AGGREGATE

A. ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.10 TEMPORARY TRENCH PATCHING

A. Conform to Section 472 of the State Standards.

PART 3 - EXECUTION

3.1 CONTRACTOR REQUIREMENTS

A. The Contractor shall perform and complete the construction work within the limits indicated in a continuous manner so that the pavement placement work may proceed without delay.

B. The Contractor shall, at all times, prior to acceptance of the work by the Engineer, maintain the completed work in a safe and satisfactory condition. All maintenance and repairs to the completed work shall be subject to the approval of the Engineer and the controlling municipal and State authorities. All maintenance and repairs of the completed work shall be provided by the Contractor at no additional cost to the Owner.

C. Equipment used in the work will be subject to approval by the Engineer and shall be maintained in a satisfactory condition at all times. Unless otherwise permitted, compaction shall be performed by use of suitable power rollers. Finished surfaces of new asphaltic surface courses shall finish even with adjacent existing pavement surfaces and be free from surface irregularities.

D. It shall be the responsibility of the Contractor to obtain from the controlling municipal authorities all required permits for cutting roadway pavements and to perform the work in accordance with all customs and requirements of the controlling authorities, in addition to those specified herein, and at no additional expense to the Owner.

E. Existing pavements outside of the indicated work limits which are damaged as a result of the Contractor's operations, including base courses, bituminous tack coats and surface courses, shall be replaced by the Contractor in accordance with the requirements specified herein for the respective type of pavement; in a satisfactory manner and at no additional cost to the Owner.

F. In case of settlement or other defects in new or replaced pavements, the Contractor shall cut out, replace, restore or repair the damaged pavements at no additional expense to the Owner. This requirement shall remain in effect for 2 years after the acceptance of the work by the Owner. The pavement area to be replaced, repaired or restored, shall extend from edge of pavement to edge of pavement, a minimum of 20 feet on either side of the defect; final pavement course shall be feathered to provide a smooth finish detail.

G. The Contractor shall furnish a bond for the 2-year duration to the Owner insuring that the corrective repairs will be performed if necessary.

H. This contract shall not be considered complete until the replacement, restoration and repair of pavements has been provided in a manner satisfactory to the Owner’s Representative, and in accordance with the requirements specified herein.

3.2 CURBING

A. Granite curbs shall be in accordance to MassDOT Standard Specifications M9.04.1 and installed in accordance to MassDOT Std. Spec. Section 500.

B. Precast concrete curbing shall conform to Subsection 501.63 and M4.02.14 of the State Standards.

C. Bituminous Berm shall conform to Hot Mix Asphalt Berm Type A in Section 501.64 of the State Standards.

D. All curbing in all locations shall be installed with concrete curb lock prior to backfill to lock curb in place at all locations on-site. Curb lock shall be 3,000 psi concrete.

3.3 SUB-BASE COURSE PLACEMENT

A. Refer to Section 310000 Earthwork.

B. Place materials in the proper lift depths and perform compaction as specified in the earthwork section. Make proper allowance for HMA courses.

C. All compaction shall be performed with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers where heavy equipment is authorized.

D. Do not operate heavy equipment closer to a foundation than a horizontal distance equal to height of backfill above bottom of foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

3.4 HOT MIX ASPHALT BASE COURSE

A. Provide a Hot Mix Asphalt Base Course on the Sub-base in compacted thickness as shown on the drawings. The Hot Mix Asphalt Base Course shall be provided in accordance with the applicable requirements of the State Standards, Section 420 or 701 as applicable and Section M3.11.00 for materials.

3.5 HOT MIX ASPHALT SURFACE COURSE

A. Place Hot Mix Asphalt Surface Course in compacted thickness as shown on drawings. The finished pavement surface shall conform to the proposed grades of the roadway or as directed, and shall be flush with all existing pavements unless otherwise indicated.

B. The Hot Mix Asphalt Surface Course shall be provided in accordance with the applicable requirements of the State Standards, Section 460 or 701 as applicable and Section M3.11.00 for materials.

C. A tack coat conforming to the State Standards shall be applied to the base course prior to the placement of the surface course.

3.6 COMPACTION

A. The Contractor shall conform to the State Standards for pavement operations, including compaction.

B. Immediately after the HMA mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when rolling does not cause undue displacement, cracking and shoving.

C. The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. Rolling shall be continued until all roller marks are eliminated and the minimum densities have been obtained based upon 95 percent of laboratory Marshall Densities made in the proportions of the job-mix formula, AASHTO T-245.

D. Steel-Tired, Static Weight Rollers: The maximum roller speeds for steel-tired static-weight rollers for various operations shall not exceed three miles per hour. The wheels of steel-wheel rollers shall be kept moist and clean to prevent adhesion of the fresh material, but an excess of water will not be permitted.

E. Vibratory Rollers: The maximum roller speed for vibratory rollers shall be that which provides impact spacing less than the compacted lift thickness. When vibratory rollers are used in the static mode, roller speed shall not exceed three miles per hour.

F. When an approved vibratory roller is used for breakdown rolling in a vibratory mode, intermediate rolling will not be required. When the vibratory roller is used for finish rolling it shall be used in the static mode. Rolling shall progress continuously until the specified density of the corresponding daily plant Marshall Density, AASHTO T-245 has been attained. Finish rolling shall continue until all roller marks are eliminated.

G. Unless otherwise directed, rolling shall start longitudinally at the sides and gradually progress toward the center of the pavement except on super-elevated curves where the rolling shall begin on the low side and progress to the high side, overlapping on successive trips by at least one-half the width of tandem rollers and uniformly lapping each preceding track.

H. The motion of the rollers shall be slow enough at all times to avoid displacement of the hot mixture. Any displacement resulting from reversing the direction of the rollers or from any other cause shall be satisfactorily corrected.

I. When the base course, binder course, or wearing course fails to comply with the density requirements herein specified, additional compaction might be applied when permitted and as directed, to attain the required density. If satisfactory density cannot be attained the Contractor shall be required to remove and replace, at his own expense, any affected area that is proven to be structurally inadequate and/or incapable of maintaining material integrity.

J. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with fresh hot mixture, which shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of HMA material shall be removed and replaced.

K. In the event of dispute as to the creditability of the results, density shall be determined from cores taken from the pavement.

3.7 TEMPORARY TRENCH PATCHING

A. Install temporary trench patch in accordance with to Section 460.62 of the State Standards.

END OF SECTION

SECTION 321313

CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:

1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.

2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

1.3 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Sidewalks
2. Vehicular Concrete Pavement
3. Detectable Warning Pavers

B. Related Sections include the following:

1. Section 310000 Earthwork

1.4 Definitions

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.5 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated. Indicate name, source, and description of each material and product.

B. Design Mixtures:

1. Submit prior to start of Work written reports of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been approved by the Engineer.

2. For each concrete pavement mixture, include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Qualification Data: For testing agency.

D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the aggregates and concrete mix with requirements indicated.

E. Batch Ticket Information: Provide concrete delivery tickets showing job name and location, date and time of delivery, quantity of concrete, quality and type of concrete, admixtures, amount of water added, and all other relevant information as described in ASTM C-94. Submit original batch tickets and 2 copies at the end of each week.

F. Field quality-control test reports.

G. Sample of Detectable Warning Paver for review by Owner

H. Submittal depicting proposed locations for expansion and control joints on all cement concrete pavement surfaces.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.7 DESIGN REQUIREMENTS

A. Design formwork to support vertical loads and lateral pressures resulting from placement and vibration of concrete in accordance with the requirements of ACI 301 and ACI 347, and as specified herein.

B. Camber the formwork to compensate for anticipated deflections due to the weight and pressure of the fresh concrete and due to construction loads.

C. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Use wedges or jacks, individually or in combination for adjustment.

D. Design forms and falsework to include assumed values of live loads, dead load, weight of moving equipment operated on formwork, concrete mix, height of drop, vibrator frequency, ambient temperature, lateral stability, and other factors pertinent to the safety of the structure during construction.

E. Provide and design forms to conform with expansion and construction joint locations

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Order concrete from batching plant so that trucks arrive at discharge locations when concrete is required. Avoid excessive mixing of concrete or delays in placing successive layers of concrete in forms.

C. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the water-cement ratio, slump, air entrainment, temperature and homogeneity.

D. Concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket will be rejected.

1.9 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Weather: Protect concrete from damage and reduced strength or performance due to weather extremes during mixing, placing and curing.

C. Cold Weather: Unless special precautions are taken to protect concrete, do not Work when temperatures are below 40°F or when temperatures are expected to fall below 40°F within 72 hours after placing concrete.

1. Comply with ACI 306 in cold weather.
2. Maintain concrete temperature of at least 60°F. Reinforcement, forms and ground in contact with concrete, shall be free of frost.
3. Keep concrete and formwork at least 50°F for at least 96 hours after placing concrete.
4. The use of calcium chloride in any form is not permitted. Non-chloride accelerator shall be used when ambient temperature is below 50°F.
5. Admixture manufacturer shall provide technical assistance at no additional cost. A manufacturer’s representative shall be available for consultation by phone or on site upon 72-hour notice.

D. Hot Weather: Concrete, when deposited, shall be less than 85°F. Cool the mix in a manner acceptable to the Engineer if the concrete temperature is higher.

1. Comply with ACI 305 in hot weather.
2. Retarder shall be used when ambient temperature exceeds 80°F.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

C. Forms for Exposed Finish Concrete: Construct formwork for exposed concrete surfaces with smooth faced undamaged plywood or metal, metal-framed plywood faced or other acceptable panel-type facing materials approved by Owner's Representative, to provide continuous, straight, smooth as-cast surfaces, and produce a uniform and consistent texture and pattern on the surfaces. Metal patches on forms for these surfaces will not be permitted. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on the drawings.

1. Use overlaid plywood complying with U.S. Product PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.
2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

D. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

E. Form Ties:

1. Form Ties: For concrete structures, which will not be in view or buried below finish grade, use carbon steel factory-fabricated, removable or stay in place snap-off type form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units, which will leave no metal closer than 1-1/2" to surface. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface. Patch all holes with non-shrink grout.
2. Form ties and spreaders for walls in areas exposed to view shall be Stainless Steel Cone–Tight Tyscru by Richmond Screw Anchor Co.; Dayton Sure-Grip and Shore Co.; or substitute approved by Engineer with Plastic cone-tight type cones having a 1" setback and a taper from 1" to 1-1/4". Tycone holes shall be sealed with plastic set back plugs, color as selected by Engineer from manufacturer's standard color selection or filled with non-shrink grout. Tyscru ties shall be sized to satisfy loading requirements.
3. In lieu of form ties specified above, fiberglass form tie systems shall be used. Fiberglass form ties shall be standard gray color. The concrete structure shall be finished by grinding the fiberglass form tie flush with the finish surface of the concrete structure.
    a. If tapered architectural holes are required, dummy tapered cones having a 1" setback and a taper from 1" to 1-1/4 shall be fastened to the interior of the formwork to achieve the specified pattern on the finish structure.

F. Chamfer Strips: Provide ¾-inch triangular fillets to form all exposed concrete corners. Material shall be rubber or polyvinyl chloride type, or smooth clear, sealed softwood.

G. Sleeves: Sleeves for wall and floor penetrations shall be pre-engineered Century-Line sleeves as manufactured by Thunderline Corporation or Engineer approved substitute. Sleeves shall be constructed of high impact thermoplastic with waterstop collar, reinforcing ribs and nailer end caps for positioning forms. Sleeve shall be designed to work with modular mechanical seal for through wall penetrations. Size of sleeves shall be selected according to manufacturer's recommendations for pipe sizes indicated on drawings.

H. Seals: Sleeve/pipe seals shall be Link-Seal modular mechanical seals as manufactured by Thunderline Corporation or approved equivalent. The seal shall be modular, mechanical; type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space

between the pipe and the wall opening. The elastomeric element shall be sized and selected per manufacturer's recommendations and have the following properties as designated by ASTM:

1. For standard service applications: (-40°F to 250°F) EPDM – ASTM D2000 M3 BA 510.
2. For hydrocarbon service applications: (-40°F to 210°F) Nitrile – ASTM D2000 M1BF510.
3. For high temperature or fire seal applications: (-60°F to 400°F) Silicone – ASTM D2000 M1GE505.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

C. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A 82/A 82M

I. Deformed-Steel Wire: ASTM A 496/A 496M.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated.

K. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.

M. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

N. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

P. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

Q. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

R. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

S. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. The Contractor shall insure that the final appearance of the sidewalks is consistent throughout the whole project. Any difference in color, texture, or finish will not be accepted by the Engineer.

1. Any portion of sidewalk or walkway that does not match the color, texture, or finish of previously constructed sidewalks will be removed and replaced with a sidewalk that matches the recently poured sidewalks at the expense of the Contractor.

B. Cementitious materials for concrete sidewalks, ramps, and pads shall conform to Section M4.02.00 Cement Concrete, (4000 psi, ¾ inch, 610) of the State Standards.

2.4 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to the State Standards, for each type and strength of normal-weight concrete required.

2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.6 PREMOLDED JOINT FILLER

A. Provide premolded–joint filler conforming to ASTM D1752, Type I or Type II.

B. Provide Type III self-expanding cork where specifically indicated.

C. Provide joint filler of same thickness as expansion joint width indicated.

D. Provide maximum length filler manufactured to minimize field splicing.

2.7 JOINT COMPOUNDS

A. Provide joint compound for expansion joints in horizontal surfaces and surfaces inclined less than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade P, Class 25. Use type T in pedestrian and vehicular traffic areas and use type NT in non-vehicular areas.

B. Provide joint compound for expansion joints in walls and surfaces inclined greater than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade NS, Class 25.

C. Provide compatible joint compounds as recommended by manufacturer when they abut each other.

D. Provide compound intended for continuous submergence in liquid containing structures.

2.8 BOND BREAKER FOR JOINT COMPOUNDS

A. Provide polyethylene tape, coated tape or metal foil.

2.9 BACK-UP MATERIAL FOR JOINT COMPOUNDS

A. Provide polyethylene foam or polychloroprene foam rubber.

B. Do not use material impregnated with oil, bitumen, or similar substances.

C. Provide back-up material as recommended by joint compound manufacturer that is compatible with the joint compound and has the same expansion/contraction capability as joint compound.

2.10 DETECTABLE WARNING PAVERS

A. Provide precast concrete unit pavers with detectable warning surface that comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act Title 49 CFR TRANSPORTATION, Part 37.9 STANDARDS FOR ACCESSIBLE TRANSPORTATION FACILITIES, Appendix A, Section 4.29.2 DETECTABLE WARNINGS ON WALKING SURFACES).

1. Pavers shall be ‘Detectable Warning Pavers’ as manufactured by Hanover Architectural Products, Hanover Pennsylvania, or approved equivalent.

B. Detectable warning pavers shall be manufactured and installed to the sizes and dimensions indicated on the Contract Documents and approved Submittals.

C. Concrete pavers shall conform to ASTM C936-82, Standard Specifications for Solid Concrete Interlocking Paving Units. The minimum compressive strength shall not be less than 7,200 pounds per square inch with the average compressive strength not less than 8,000 pounds per square inch Maximum absorption shall be 5 percent or less at 50 cycles of freeze-thaw testing per section ASTM C67. Submit paver tests for freeze thaw and abrasion resistance to be approved by the Architect.

1. Paver size shall be 11-¾ inch square with beveled top edges.
2. Paver thickness shall be 2 inches.
3. Width and thickness shall not vary by greater than 1/16 inch.
4. The finish shall be non-slip texture.
5. Paver color shall be ‘Charcoal’ from manufacturer’s standard color range which provides a 60% color contrast from the abutting ramp pavement color, as required by the Americans with Disabilities Act.

D. Mortar for Detectable Warning Pavers

1. Mortar for grouted joints between pavers shall be a cement mortar composed of one part Portland cement and two parts sand, by volume with sufficient water to form a workable, stiff mixture.
2. Setting bed mortar shall conform to ASTM C 270, Type S, except that latex polymer additive shall be mixed with the cementitious materials and aggregate in lieu of water.
3. Cement: Shall be an American portland cement conforming to ASTM C150, Type I or II, except Type III may be used for cold-weather construction, and shall exhibit no efflorescence when cast into 2 inch x 7 inch x ½ inch (50 mm x 178 mm x 13 mm) slabs comprising the mortar under test.
4. Water: clean, fresh and potable, from public water system.
5. Sand: clean, washed, uniformly well-graded, conforming to ASTM C144 with 100 percent passing No. 8 sieve (2.37 mm), and not more than 35 percent passing No. 50 sieve (300um), with a fineness modulus maintained at 2.25 plus or minus 0.10.
6. Hydrated Lime: provide plastic hydrate, conforming to ASTM C207, Type "S" as approved by the Owner's Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in SECTION 310000 EARTHWORK.

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

D. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

C. General:

1. Construct forms as designed and in accordance with Contractor's approved working drawings conforming to ACI 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, level, and plumb work in finished structures.
2. Provide for openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required. Use selected materials to obtain required finishes.

3. Forms for concrete which accommodate work of other trades, fabricated before the opportunity exists to verify the measurements of adjacent construction, shall be accurately sized and located as dimensioned on the Drawings. In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions as approved by the Engineer, at no cost to the Owner.

D. Fabrication:

1. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage concrete surfaces.
2. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to temporary openings on forms in as many inconspicuous locations as possible, commensurate with design requirements. Form intersecting planes to provide true, clean cut corners.

E. Falsework:

1. Erect falsework and support, brace, and maintain it to safely support vertical, lateral, and asymmetrical loads applied until complete structure has attained design strength. Construct falsework so that adjustments can be made for take-up and settlement, and access is provided for inspection.
2. Provide wedges, jacks or chamfer strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to product work of required dimensions.

F. Forms for Exposed Concrete:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes
2. Provide sharp clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or grits to maintain true, square intersections.
3. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material, which will produce bow.

G. Corner Treatment:

1. Unless shown otherwise, form chamfers with ¾-inch by ¾-inch strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

H. Control Joints: Locate as indicated on the Drawings.

I. Provision for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Verify size and location of openings, recesses and sleeves with the trade requiring such items. Accurately place and securely support items to be built into forms.

J. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove encrusted mortar and grout, chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.3 REMOVAL OF FORMS

A. Formwork not supporting concrete, such as sides of walls, columns, and similar parts of the Work, may be removed after cumulatively curing at not less than 50 degrees F for 72 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as elevated beams, joists, slabs and other structural elements may not be removed until concrete has attained 70% of its design minimum 28-day compressive strength, and has cumulatively cured for no less than 7 days. Concrete shall have sufficient strength to safely support its own weight and construction live loads and lateral pressures. Determine potential compressive strength of in-place concrete testing field-cured specimens representative of the concrete location or members in accordance with State Standards.

C. Form facing material may be removed one day after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

D. Form ties: The concrete structure shall be finished by grinding the fiberglass form ties flush with the finish surface of the concrete structure.

3.4 REUSE OF FORMS

A. 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. When forms are reused for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Apply new form releasing agent to all form areas that will be in contact with concrete.

B. Do not reuse forms if there is any evidence of surface wear and tear, splits, fraying, delamination or other damage which would impair the quality of the concrete surface or prevent obtaining the specified concrete finish.

3.5 STEEL AND WELDED WIRE FABRIC REINFORCEMENT

A. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

B. Place steel or welded wire fabric in conformance with the construction methods specified within the State Standards.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.6 CONSTRUCTION JOINTS

A. Locate and install construction joints as indicated or, if not indicated, locate so as not to impair the strength and appearance of the structure. Submit proposed construction joint locations for approval.

B. The Contractor shall score the concrete sidewalks in conformance with the scoring pattern shown on the Drawings where specified.

C. Where the scoring pattern is not specified, the Contractor shall score the concrete sidewalk in conformance with the State Standards.

D. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints.

E. Key groove all construction joints unless otherwise indicated. Wall horizontal joints need not be keyed except where specifically indicated.

F. Key grooves shall be one-third the thickness of the thinner member and 1-1/2-in. deep unless otherwise indicated.

G. Use tapered key groove forms to permit form removal without damage to the groove. Taper not to exceed 2 inches per foot.

H. Center waterstops in construction joints unless otherwise indicated. Secure waterstops in position by tie wire to adjacent reinforcing every 12 inches.

I. Consolidate concrete during placement in the vicinity of key groove without damaging or dislodging waterstop.

J. Remove all key groove forms.

K. Clean key groove of laitance, curing compound, foreign materials and protrusions of hardened concrete. Roughen by bush hammer or lightly sandblast to expose coarse aggregate. Blow out debris and dust with oil-free compressed air.

L. Protect exposed key groove and waterstop from damage.

M. Expansion Joints:

1. Install expansion joints in accordance with the manufacturers printed instructions and as indicated.
2. Center waterstops in expansion joints unless otherwise indicated. Secure waterstops in position by tie wire to adjacent reinforcing every 12 inches.
3. Consolidate concrete during placement in vicinity of expansion joint without damaging premolded joint filler and waterstop.

3.7 PREMOLDED JOINT FILLER

A. Treat cut surface of premolded joint filler in conformance with manufacturer’s printed instructions.

B. Place premolded joint filler against the bulkhead form and fasten to the inside of the form with noncorrosive fasteners. Remove all fasteners when bulkhead form is removed.

C. Prevent disturbance of or damage to premolded joint filler.

D. Fill expansion joint completely with premolded joint filler, except as specified below.

E. Secure wood strips to expansion joint surfaces, which are to receive joint compound.

F. Use tapered wood strips with the smaller width being the same width as the expansion joint and of depth necessary to install the joint compound and back-up materials.

G. Use materials to secure the premolded joint filler and wood strips that will not harm concrete or affect the joint compound bond to concrete.

H. Do not remove wood strips until forms are removed as specified in 3.3REMOVAL OF FORMS.

I. Clean groove of laitance, curing compound, foreign materials and protrusions of hardened concrete. Blow out debris and dust with oil-free compressed air.

3.8 JOINT COMPOUND

A. Seal the dry clean concrete in expansion joints in conformance with manufacturer's printed instruction.

B. Install back-up and bond breaker materials.

C. Prime concrete, fill flush with joint compound or required thickness, tool to concave shape and seal in conformance with manufacturer's printed instructions and ASTM C1193.

D. Prevent spilling joint compound over adjoining surfaces. Use tape adjacent to joint as required. Remove all tape completely from concrete surface after installing joint.

E. Do not prime concrete or install joint compound when compound, air or concrete temperature is less than 40 deg. F. or as required by manufacturer.

3.9 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site.

F. Do not add water to fresh concrete after testing.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only

square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.

J. Screed pavement surfaces with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

M. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

N. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.10 FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true

planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

C. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.11 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. 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.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
2. Water.
3. Continuous water-fog spray.
4. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
5. 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, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
6. 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.

3.12 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: 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 at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.
2. 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.
3. 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 mix. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 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.

D. 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.

E. 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.

F. 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.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.14 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section at no expense to the Owner.

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. 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. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

3.15 DETECTABLE WARNING PAVERS

A. No pavers shall be laid in inclement weather or when the temperature is 36 degrees Fahrenheit, and dropping, nor shall any work be done on rising temperatures until the temperature reaches 32 degrees Fahrenheit. Frozen mortar materials shall not be used.

B. Concrete detectable warning pavers shall be set on a mortar setting bed over a prepared concrete base slab. All setting shall be done by competent workmen under adequate supervision. Do any cleaning necessary to cement concrete base to provide a clean base surface, free from dust, oil, grease, other impurities, or loose or friable particles.

C. Damp the surface immediately before placing the mortar setting bed, but do not allow free water to remain on the surface.

D. Latex modified mortar setting bed shall be spread evenly over moistened concrete base. Mortar setting bed shall be 3/4--inch thick, minimum. Back butter pavers with latex modified mortar to ensure a full bond between pavers and setting bed.

E. Before setting, the back of each piece of concrete paver shall be dampened. Each piece shall be carefully bedded into a wet, sticky mortar mixture and tapped home to a full and solid bearing. Particular care shall be exercised to equalize bed and joint openings and eliminate the need for redressing of exposed surfaces.

F. Exposed surfaces of pavers shall be kept free from bed mortar at all times. Any bed mortar smears shall be immediately removed with a clean sponge and clean water before latex modified mortar can set.

G. Pavers shall be set true to the required lines and grades in the pattern detailed on the Contract Documents.

H. Joints between pavers shall be filled with mortar to prevent water intrusion.

END OF SECTION

SECTION 32 12 13

LANDSCAPE CAST-IN-PLACE CONCRETE PAVING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The conditions and general requirements of the Contract, Division 0 and applicable parts of Division 1, apply to the work under this Section.

1.2 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. Provide all labor, equipment, implements and materials required to furnish, install, construct and perform all paving operations complete as shown on drawings and specified herein.

B. Work includes, but is not limited to the following:

1. Concrete for all exterior pedestrian pavement and walkways;

C. Related Work: Examine all other sections of the Specifications and all Drawings for the relationship of the work under this Section and the work of other trades. Cooperate and coordinate all work under this Section.

D. The following related items are included under the Sections list below:

1. Section 31 00 00 – Earthwork
2. Section 32 10 00 – Bases, Ballasts, and Paving
3. Section 33 00 00 – Utilities

1.3 DEFINITIONS

A. The following related items are included herein and shall mean:

1. S.S.H.B. – Standard Specifications for Highways and Bridges, the Commonwealth of Massachusetts, Department of Public Works, latest edition.
2. A.S.T.M. – American Society for Testing and Materials.
3. A.A.S.H.T.O. – American Association of State Highway and Transportation Officials.

1.4 JOB CONDITIONS

A. Start of work under this Section shall constitute acceptance of the foundation conditions to which this work is to be applied. Any defects in work resulting from such conditions shall be corrected under this Section, at no extra cost to the Owner.

B. Maintain sub-base in satisfactory condition and properly drained until surface improvement is placed.

1.5 SUBMITTALS

A. All manufacturers' product literature.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Approved samples will become the Landscape Architect's control samples.

C. Samples of sandblasted concrete; Light and Medium Finish

1.6 LAWS, ORDINANCES, PERMITS AND FEES

A. The Contractor shall:

1. Give necessary notices, obtain all permits and pay all governmental taxes, fees and other costs in connection with this work, file all necessary plans, prepare documents and obtain all necessary approvals.
2. Obtain all required certificates of inspection for this work and deliver same to the Landscape Architect before request for acceptance and final payment for the work.

3. Include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, drawings (in addition to contract drawings and documents) in order to comply with all applicable laws, ordinances, rules and regulations of the City of Boston and the Commonwealth of Massachusetts, whether or not shown on the Drawings and/or specified.

1.7 DEFINITIONS

A. The following related items are included herein and shall mean:

1. S.S.H.B. - Standard Specifications for Highways and Bridges, the Commonwealth of Massachusetts, Department of Public Works, latest edition
2. A.S.T.M. - American Society for Testing and Materials
3. A.A.S.H.T.O. - American Association of State Highway and Transportation Officials

1.8 SUBSURFACE INFORMATION

A. The Owner assumes no responsibility for the Contractor's failure to make his own site investigation and makes no representation regarding the character of the soil or subsurface conditions which may be encountered during the performance of the work.

1.9 FINISH GRADES

A. The words "finished grades" as used herein mean the required final grade elevations indicated on the Drawings. Where not otherwise indicated, site areas shall be given uniform slopes between points, for which finished grades are shown, or between such points and existing grade except that vertical curves or roundings shall be provided at abrupt changes in slope.

1.10 GRADES AND ELEVATIONS

A. The Drawings indicate, in general, the alignment and finished grade elevations. The Landscape Architect, however, may make such adjustments in grades and alignment as are found necessary in order to avoid interference and to adapt the grading to other special conditions encountered.

PART 2 - PRODUCTS

2.1 CAST-IN-PLACE CONCRETE

A. Cast-in-place concrete shall be Class D, air-entrained concrete conforming to the requirements and applicable provisions of Section 701 of the S.S.H.B. Minimum 28-day compressive strength shall be 5,000 psi. Concrete shall be air-entrained 5% minimum with a one (1") to three (3") inch maximum slump.

B. Form Materials

1. Forms of Exposed Finished Concrete: Unless otherwise indicated, construct form work for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practical sizes to minimize number of joints and to conform to the joint system shown on Drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
3. Form for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finish structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
4. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

C. Reinforcing Materials

1. Reinforcing Bars: ASTM A615, Grade 60.
2. Welded Wire Fabric (WWF): ASTM A185, welded steel wire fabric.
3. Supports for Reinforcement: Provide supports for reinforcement including bolsters, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable.

D. Cement

1. Cement shall be Portland Cement Type 1, free from water-soluble salts or alkalis which will cause efflorescence on exposed surfaces. Portland Cement shall comply with Standard Specifications of the ASTM-C150 Type I or II.
2. Cement shall be stored in a weather-tight structure and in such a manner as to prevent deterioration or intrusion of foreign matter. It shall be easily accessible for proper inspection and identification of each shipment. Cement that has hardened or partially set shall not be used.
3. Standard structural cement mixes suitable for a brush off abrasive blasting finish only. Light, medium or coarse blast should only be specifies when gap-graded or architectural aggregate mix is used.

E. Aggregate

1. Fine aggregate for all concrete shall consist of washed inert natural sand conforming to ASTM-C330.
2. All other aggregate shall conform to ASTM C-33. Provide aggregates with a long history of successful use in similar work and conditions. Grade fine aggregates from ¼" to fines. Grade coarse aggregates from ¼" to size specified.

F. Water

1. Water for concrete shall be clean, potable, and free from deleterious substances.
2. When subjected to the mortar strength test described in ASTM-C87 the strength at 28 days of mortar specimens made with the water under examination and normal Portland Cement shall be at least 100% of the strength of similar specimens made with distilled water.

G. Related Materials

1. Grout: Non-shrink, non-metallic grout. Provide one of the following (or approved equal):

    a. "Five Star Grout": U.S. Grout Company.
    b. "Masterflow 713": Master Builders.

2. Chemical Hardener (chHD-Fn): Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.
3. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
4. Moisture-Retaining Cover: One of the following, complying with ASTM C171.

    a. Waterproof paper
    b. Polyethylene film.
    c. Polyethylene-coated burlap

5. Filler strips for expansion joints where used with caulking or sealants shall be cork type, non-extruding, self-expanding filler strips, AASHO M-153-111, ASTM D1752, III, as manufactured by Celotex Corporation, W.R. Meadows, Inc., W.R. Grace and Company, or equal. Where no sealant is required strips may be non-extruding bituminous type in accordance with ASTM D1751.
6. Admixtures

    a. Admixtures causing accelerated setting of the cement in concrete shall not be used.
    b. In general, all concrete shall not contain additives, but an admixture may be employed therein (to improve workability, durability, etc.) subject to prior test and/or approved by the Landscape Architect in writing.
    c. Water-reducing and air-entraining agents shall be used in concrete, as required by the Landscape Architect, in strict accordance with the manufacturer's printed instructions. Agents shall be stored safe from adverse temperature in accordance with manufacturer's printed instructions. Total air entrained in freshly mixed concrete shall be 5.0% plus or minus 1.0% of volume of concrete with required strengths maintained.
    d. Water-reducing agent: "Sonotard WR" by Sonneborn Building Products, "WRDA" by W.H. Grace Company, "Pozzolith 100" by Master Builders Company, or equal. Water reducing agent must be by same manufacturer as air-entraining agent.
    e. Air-entraining Agent: "Darex" by W.R. Grace Company, "Aerolith" by Sonneborn Building Products, "MB-VR" by Master Builders Company, "Sealtight Air Entraining Agent" by W.R. Meadows, or equal.
    f. No other admixtures may be used without Landscape Architect's approval.

H. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps and sloping surfaces: Not more than 3".

2. Other concrete: Not less than 1" and not more than 4".

I. Curing Compounds

1. All curing compounds shall conform to requirements of ASTM Designation C-309, Type I, clear and C-156. No materials containing wax or saponifiable materials will be permitted.
2. Curing compound in areas that will be exposed to view in the finished work, or to receive a painted finish, and areas to receive a concrete topping or ceramic tile mortar beds, seamless composition flooring, synthetic athletic surfacing, or other similar finishes, shall contain a fugitive dye, and shall be of a type that will become brittle and easily removable after about 3 weeks to allow dust-proofing treatment specified here in after.
3. Curing compound shall be Master Builders "Master Seal", Symons "Cure and Seal", Sonneborn "Kure-N-Seal", "CS-309" by W.R. Meadows or equal, conforming to ASTM 309, Type 1 and 2.

J. Proportioning and Design of Mixes

1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Landscape Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Landscape Architect.
2. Submit written reports to Landscape Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Landscape Architect.
3. Adjustments to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Landscape Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Landscape Architect before using in work.

K. Concrete Mix

1. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd. or fraction thereof.

2. Provide batch ticket for each batch discharged and use in work indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
3. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.
4. Addition of water to the batch for material with insufficient slup will not be permitted.
5. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.
6. When air temperature is between 85 Deg. F (30 deg. C) and 90 Deg. F (32 deg. C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 Deg. F. (32 deg. C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 SITE INVESTIGATION

A. Contractor shall visit the site to determine the full extent of the site preparation and demolition work and any other matters that in any way affect the Work. Failure of the Contractor to acquaint himself with all available information concerning conditions will not relieve him from responsibility for estimating the difficulty or the cost of the Work.

3.2 GRADES AND ELEVATIONS

A. Establish the lines and grades in conformity with the Drawings. Establish and maintain suitable stakes or batters at points where spot elevations are given on the Drawings and at any other points to be graded as directed by the Landscape Architect. Maintain sufficient reference points at all times during construction to properly perform the Contract installation.

3.3 CAST-IN-PLACE CONCRETE

A. Formwork

1. Forms shall conform to the lines, dimensions and shapes of concrete shown providing for openings, recesses, keys, slots, beam pockets and projections as required.
2. Make forms clean and free of foreign material before placing concrete.
3. Do not use earth cuts as forms for vertical surfaces, unless approved by the Landscape Architect.
4. Design of Formwork

a. Comply with ACI 301, Chapter 4, Paragraph 4.2. Formwork drawings shall bear the seal of licensed professional engineer.
b. Form rods and tie wires of exterior surfaces shall slope down form the inside to outside of forms.
c. Provide forms so that no discernible imperfection is in evidence in finished concrete surfaces due to deformation, bulging, jointing, or leakage of forms.

5. Tolerance

a. Comply with ACI 301, Chapter 4, Paragraph 4.3, except as otherwise noted.

6. Preparation of form Surfaces

a. Comply with ACI 301, Chapter 4, Paragraph 4.4
b. Use non-staining mineral oil or form lacquer.

B. Reinforcement

1. General: Comply with ASI 301, Chapter 5, Paragraph 5.4.
2. Placing Tolerance: Comply with ACI 301, Chapter 5, Paragraph 5.4.
3. Placing

a. Comply with ACI 301, Chapter 5, Paragraph 5.5. When splices not shown on the Drawings are approved by the Landscape Architect, such splicing shall conform to ACI 318.
b. Place reinforcing bars having assigned positions so that distinguishing marks agree with those given on the Shop Drawings relating to or calling for bars.
c. Secure all reinforcing bars in place with high-density plastic supporting and spacing devices and metal tying devices. Reinforcing in concrete members that have one or more surfaces exposed, whether painted or unpainted finish, shall be tied with 14 gauge soft annealed galvanized wire. Uncoated tie wire in exposed members will not be accepted.

4. Minimum Reinforcement: Where no other reinforcement is shown for concrete fill or toppings, provide 6x6 - W1.4XW1.4 welded wire.

C. Mixing Concrete

1. Ready Mix Concrete

a. Comply with ASTM C94.
b. Add mixing water only at the site.
c. Discharge the concrete completely at the site within 1-1/2 hours after the introduction of the cement to the aggregates. In hot weather reduce this time limit so that no stiffening of the concrete shall occur until after it has been placed.
d. Begin the mixing operation within thirty minutes after the cement has been intermingled with the aggregates.

2. Batch Mixing at Site

a. Comply with ACI 301, Chapter 7, Paragraph 7.2.
b. Excessive mixing requiring the addition of water to preserve the required consistency will not be permitted. Mix concrete to a consistency which can be readily placed without segregation.
c. Where admixtures are specified, equip mixers with a device for measuring and dispensing the admixture.

3. Hand-Mixed Concrete: When hand-mixed concrete is allowed and approved for certain parts of the work, mix on watertight platforms. Proportion cement, sand and aggregate loose by volume, carefully measured. Thoroughly mix sand and cement together dry until the mixture is a uniform color. Add the aggregate and turn the mass over until the mixture is uniform and homogeneous. Add water by sprinkling and turn the mass over until it is uniformly mixed and of the required consistency.

D. Joints and Embedded Items

1. Construction and Control Joints

a. Comply with ACI 301, Chapter 6, Paragraph 6.1.
b. When construction and control joints are required or permitted, obtain bond by roughening the surface of the concrete in a manner which will expose the aggregate uniformly and will not leave loosened particles of aggregate or damaged concrete at the surface. Saturate the cleaned surface with water and slush with a coating of 1: 1-1/2 cement-sand grout. Place new concrete before grout has attained its initial set. Clean horizontal construction joints and pour the cement-sand mortar over

joints in walls to a depth of 1 in. before depositing concrete. In walls, do not space construction joints more than 40 feet apart, unless otherwise shown.

2. Expansion Joints

   a. Comply with ACI 301, Chapter 6, Paragraph 6.2.b. Install joint filler to allow the required dimension for sealant, as indicated. Dimensions shown on Drawings are based on an assumed design temperature of 70 deg. F. Concreting procedures shall take into account the ambient temperature range at the time of the respective operations.
   b. Sealant to comply with Mass Highway SSHB requirements.

3. Embedded Items

   a. Comply with ACI 301, Chapter 7, Paragraph 6.4 and 6.5.
   b. Accurately set anchorage devices by line and transit, and coordinate in locating of all anchorage devices to be set for the accommodation of all work.
   c. Locate anchor bolts as shown on the Drawings and on Shop Drawings. Obtain necessary templates from manufacturers or other trades as required for the proper setting of anchor bolts and other items.
   d. Assist other trades in the installation of piping, pipe sleeves, conduit, and similar items where such items are to be installed in concrete. Provide frames to securely hold anchor bolts and anchorage devices in place during construction, and take care that no displacement occurs during the pouring of concrete. Under this Section furnish and set items using approved standard type items suitable for their intended purpose.

E. Placing Concrete

1. Preparation Before Placing: Conform to ACI 310, Chapter 8, Paragraph 8.1.
2. Conveying

   a. Comply with ACI 301, Chapter 8, Paragraph 8.2.
   b. Provide a spout or downpipe and elephant trunk or other appropriate method to prevent concrete from falling freely through a height greater than 3 feet.

3. Depositing: Comply with ACI 301, Chapter 8, Paragraph 8.3.

F. Curing

1. Comply with ACI 301, Chapter 12. Moist cure (continuous free water and cover with burlap) for first five (5) days after casting. Protect against temperatures under 40 deg. F. in first five days.

G. Form Removal

1. Do not remove forms until the concrete has thoroughly hardened and has attained sufficient strength to support its own weight and construction live loads to be placed thereon, without damage to the structure. In general, do not disturb forms for framing until the concrete has attained at least 40% of design strength for side forms and 80% of design strength for bottom forms. Remove no forms for 24 hours after placing concrete. Protect concrete walks from pedestrian traffic for a period of 3 days after placing. Damp cure as per standards above. Be responsible for proper form removal and replace any work damage due to inadequate maintenance or improper or premature form removal.
2. Where use of metal form ties extending to within less than 1-1/2 in. of the face of permanently exposed concrete has been unavoidable, cut off such ties at least 1-1/2 in. deep in the concrete but not less than 72 hours after concrete has been cast. Remove forms by methods which will not spall the concrete or cause any injury whatsoever. Hammering or prying against concrete will not be permitted.

H. Patching

1. Comply with ACI 301, Chapter 9.

I. Finishing

1. General Requirements for Flatwork:

a. Strike off top surfaces of finished fill and monolithic slabs true and level within a tolerance of 1/8 in. in 10 ft. and measured with a 10 ft. straightedge placed in any direction at any location.
b. Set edge forms and intermediate screed strips accurately and sufficiently rigid to support screeds and so that proper surface elevations and concrete thickness are achieved allowing for dead load deflection and camber of formwork. Take measurements and control tolerances by the use of transit instrument.
c. Upon completion of leveling, remove screed and fill spaces with concrete.

d. Concrete shall have a medium broom finish of parallel marks, unless otherwise indicated on the drawings. Brooming shall be at right angles to the axis of walk or as shown on the Drawings.
e. Joints and edges shall be sawn or otherwise finished as shown on the Drawings.

2. Sand Blast Finish: Perform sand blasting after compression strength of concrete exceeds 2000 psi within 24 to 72 hours of placement. Coordinate with formwork removal to ensure that surfaces to be sand blasted are treated at same age for uniform results.

a. Surface Continuity: Perform sand blasting finishing in a continuous an operation as possible, maintaining continuity of finish on each surface or area of work. Maintain required patterns or variances in depth of blast to match design reference sample or mockup.
b. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surface to match design reference sample or mockup, as follow:

1) Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color. Maximum reveal 1/16-inch.
2) Medium: Generally exposed coarse aggregate with slight reveal. Maximum reveal 1/8-inch.

c. Sand Blasting: Abrasive blast edges of patterns carefully using back-up boards, to maintain uniform corner of edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
d. Concrete which has been over-blasted shall be removed and replaced at the Contractor's expense.
e. Concrete cleaning: After abrasive blasting to required depth is completed, clean surface with commercial concrete cleaner, as produced by ProSoCo or equal, according to the manufacturer's instructions and recommendations.

1) Thoroughly neutralize and flush cleaning solution from finished surfaces with water under pressure.
2) Back-up boards shall be used with abrasive blast edges to maintain uniform edge line. Protect all concrete surfaces not being sandblasted or that is being sandblasted to a different finish.

J. Grout

1. Mix grout in accordance with the approved manufacturer's instructions to a consistency which will permit placement. Place grout so as to ensure complete bearing and elimination of air pockets.

K. Field Quality Control

1. Sampling and testing for quality control during placement of concrete may include the following, as directed by the Landscape Architect.

    a. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
    b. Slump: ASTM C143, one test for each concrete load at point of discharge; and one test for each set of compressive strength test specimens. SLUMP TESTS REQUIRED.
    c. Air Content: ASTM C173, volumetric method for lightweight or normal weight concrete; one for each set of compressive strength test specimens.
    d. Concrete Temperature: Test hourly when air temperature is 40 deg. F (4 deg. C) and below, and when 80 deg. F (27 deg. C) and above; and each time a set of compression test specimens made.
    e. Compression Test Specimen: ASTM C31; one set of 6 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
    f. Compressive Strength Tests: ASTM C39; one set for each 100 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 5,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
    g. When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Landscape Architect if, in his/her judgement, adequate evidence of satisfactory strength is provided.
    h. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
    i. Strength level of concrete will be considered satisfactory if average of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.

2. Test results will be reported in writing to Landscape Architect and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day test.
3. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Landscape Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.
4. Requirements of Regulatory Agencies: Comply with air pollution regulations of governing authorities for sandblasting activities and operations.
5. Suitable protective measures shall be taken by the Contractor to ensure that no damage occurs to any other surfaces when carrying out any sandblasting operations.

END OF SECTION

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SECTION 321723

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:
1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.

2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

1.3 SUMMARY

A. This Section includes the following:

1. Pavement-marking paint.

B. Related Sections include the following:

1. Section 321217 Hot Mix Asphalt Paving

1.4 DEFINITIONS

A. DOT: Massachusetts Department of Transportation

1.5 SUBMITTALS

A. Product Data: For each type of product indicated include technical data and composition of materials proposed.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international graphics symbol, spaces dedicated to people with disabilities.

D. Qualification Data: For manufacturer.

E. Material Test Reports: For each paving material.

F. Conformance Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the State Standards.

1.7 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.

1.8 PROJECT CONDITIONS

A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKINGS

A. Pavement markings shall be epoxy resin conforming to the State Standards Section 860 Reflectorized Pavement Markings.

B. Pavement markings shall be “yellow” or “white” in color as specified on the Drawings.

C. Glass Beads shall conform to State Standards Section M7.01.07.

D. Pavement marking stripes shall measure 4 inches in width or as specified on the Drawings.

E. Waterborne pavement markings are not acceptable.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING INSTALLATION

A. Install pavement markings in accordance with State Standards Section 860. Refer to the Drawings for the thickness and color of the pavement markings.

B. Install letters using stencils to provide clean edges. Letters shall be standard height, font and width per the State Standards.

3.2 TRAFFIC CONTROL AND PROTECTION

A. Place warning signs near the beginning of the work site and well ahead of the work site for alerting approaching traffic from both directions. Place small markers along newly painted lines to control traffic and prevent damage to newly painted surfaces. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

3.3 QUALITY ASSURANCE

A. Demonstrate success of bond of reflective media, new paint marking and the pavement surface, vacuum cured surface of new marking after a seven (7) day dry time. Inspect newly applied markings for signs of bond failure based on visual inspection.

END OF SECTION

SECTION 323223

SEGMENTAL RETAINING WALLS

PART 1 - GENERAL

1.1 SCOPE

A. Work includes furnishing and installing segmental retaining wall (SRW) units to the lines and grades designated on the construction drawings or as directed by the Owner. Also included is furnishing and installing appurtenant and incidental materials required for construction of the retaining walls as shown on the construction drawings.

1.2 REFERENCES

A. The following standards and specifications listed below form a part of this specification where applicable.

1. Segmental Retaining Wall Units.
   a. ASTM C 140 - Sampling and Testing Concrete Masonry Units.
2. Geosynthetic Reinforcement.
   a. ASTM D 4595 -Tensile Properties of Geotextiles by the Wide-Width Strip Method.
   b. ASTM D 5262 -Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics.
   c. GRI:GG1 - Single Rib Geogrid Tensile Strength.
   d. GRI:GG5 - Geogrid Pullout.
3. Soils.
   a. ASTM D 698 - Moisture Density Relationship for Soils, Standard Method.
   b. ASTM D 422 - Gradation of Soils.
   c. ASTM 4318 - Atterberg Limits of Soil.
4. Drainage Pipe.
   a. ASTM 3034 - Specification for Polyvinyl Chloride (PVC) Plastic Pipe.
   b. ASTM D1248 - Specification for Corrugated Plastic Pipe.
5. Where specifications and reference documents conflict, the Owner shall make the final determination of applicable document.

B. Existing Conditions Plan compiled from the following sources:
1. Existing conditions mapping taken from plan entitled Existing Conditions Plan 152 Park Street North Reading, MA" prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.
2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

1.3 SUBMITTALS

A. Material Submittals.

1. The Contractor shall submit manufacturers' certifications two weeks prior to start of work stating that the intended SRW units and geosynthetic reinforcement meet the requirements of Section 2 of this specification.
2. Submit representative block samples for selection of color and texture of exposed wall face(s) to the Owner.

B. Design Submittal:

1. The Contractor shall submit two sets of detailed design calculations and construction drawings for review and acceptance at least two weeks prior to the beginning of wall construction. All calculations and drawings shall be prepared, signed and sealed by the Wall Design Engineer, a Professional Engineer experienced in SRW wall design and licensed in the Commonwealth of Massachusetts.

1.4 DELIVERY, STORAGE AND HANDLING

A. Contractor shall check materials upon delivery to assure that specified type and grade of materials have been received and proper color and texture of SRW units have been received.

B. Contractor shall prevent excessive mud, wet concrete, epoxies, and like materials that may affix themselves by unintentional contact with SRW materials.

C. Contractor shall store and handle materials in accordance with manufacturer's recommendations.

D. Contractor shall protect materials from damage. Damaged materials shall not be incorporated into the retaining wall.

E. Exposed faces of precast modular block units shall be reasonably free of chips, cracks, or stains when viewed from a distance of 10 feet.

PART 2 - PRODUCTS

2.1 SEGMENTAL RETAINING WALL

A. SRW units shall be machine formed, Portland Cement concrete blocks specifically designed for retaining wall applications.

B. Color of SRW units to be selected by the Owner. See Materials submittal requirements for further information in selection of applicable color(s).

C. SRW units shall be solid through the full depth of the unit.

D. SRW units shall have a depth (front face to rear) to height ratio of 2:1, minimum.

E. SRW units shall be interlocked with connection pins, designed with proper setback to provide 8:1 vertical to horizontal batter (a 7 degree cant from vertical).

F. SRW units shall be capable of being erected with the horizontal gap between adjacent units not exceeding 1/8 inch.

G. For any corners shown on the construction plans, SRW units shall be capable of providing overlap of units on each successive course so that walls meeting at corner are interlocked and continuous. SRW units that require corners to be mitered shall not be allowed.

H. SRW units shall be capable of providing a split face, textured surface for all vertical surfaces that will be exposed after completion of wall, including any exposed sides and backs of units.

I. SRW units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the structure. Cracking or excessive chipping is grounds for rejection. Units showing cracks longer than 1/2"

shall not be used within the wall. Units showing chips visible at a distance of 30 feet from the wall shall not be used within the wall.

J. Concrete used to manufacture SRW units shall have a minimum 28-day compressive strength of 3,000 psi and a maximum moisture absorption rate, by weight, of 8% as determined in accordance with ASTM C 140. Compressive strength test specimens shall conform to the saw-cut coupon provisions of Section 5.2.4 of ASTM C140 with the exception that the Coupon shall be taken from the least dimension of the unit of a size and shape representing the geometry of the unit as a whole.

K. SRW units' molded dimensions shall not differ more than + 1/8 inch from that specified, except height which shall be + 1/16 inch as measured in accordance with ASTM C140.

2.2 SEGMENTAL RETAINING WALL UNIT CONNECTION PINS

A. SRW units shall be interlocked with connection pins, of the material, size, and dimension as recommended and by the wall system manufacturer.

2.3 GEOSYNTHETIC REINFORCEMENT

A. Geosynthetic reinforcement shall consist of geogrid or geotextile manufactured as a soil reinforce-ment element. The manufacturers/suppliers of the geosynthetic reinforcement shall have demonstrated construction of similar size and types of segmental retaining walls on previous projects.

B. The type, strength, and placement location of the reinforcing geosynthetic shall be determined by the Wall Design Engineer, and shown on the design submittal.

2.4 LEVELING PAD

A. Material for leveling pad shall consist of compacted sand, gravel, or combination thereof and shall be a minimum of 6 inches in depth. Lean concrete with a 28 day compressive strength of 200-300 psi and three inches thick maximum may also be used as a leveling pad material. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lowermost SRW unit.

2.5 DRAINAGE AGREGATE

A. Drainage aggregate shall be angular, clean stone or granular fill meeting the following gradation as determined in accordance with ASTM D422.

Sieve Size	Percent Passing
1 inch	100
3 / 4 inch	75 – 100
No. 4	0 – 60
No. 40	0 – 50
No. 200	0 - 5

2.6 DRAINAGE PIPE

A. The drainage collection pipe shall be a perforated or slotted PVC, or corrugated HDPE pipe. The drainage pipe may be wrapped with a geotextile to function as a filter.

B. Drainage pipe shall be manufactured in accordance with ASTM D 3034 and/or ASTM D 1248.

2.7 REINFORCED (INFILL) SOIL

A. The reinforced soil material shall be free of debris. Unless otherwise noted on plans prepared by the Wall Design Engineer, the reinforced material shall consist of the inorganic USCS soil types GP, GW, SW, SP, SM meeting the gradation for common borrow as indicated in Earthwork (Section 02200).

B. The maximum particle size of poorly-graded gravels (GP) (no fines) should not exceed 3/4 inch unless geosynthetic strength is reduced to account for additional installation damage from particles larger than this maximum.

C. The plasticity of the fine fraction shall be less than 20.

2.8 SOIL

A. The following soil parameters shall be for preparation of final design documents by the Wall Design Engineer, unless otherwise directed by the Owner:

Strata	Unit Weight (pcf)	Internal Friction Angle (degrees)	Cohesion (c) (psf)
Reinforced Fill	125	33	0
Retained Soil	125	30	0
Foundation Soil	125	30	0

B. The design of the permanent wall system shall include an allowance of at least a two foot (2 ft) depth uniform vertical soil surcharge loading where walls retain roadway fills. This provision is applicable when the distance from the face of wall to the edge of road is less than the design wall height.

C. The wall system may also be designed to account for reasonable temporary surcharge conditions during construction, such as those due to stockpiling of soil or other construction materials.

D. The construction drawings shall indicate the design limitations of the wall system.

E. Should the actual soil conditions observed during construction differ from those assumed for the design, the Wall Design Engineer shall review the design.

F. The Wall Design Engineer shall perform the field work and testing necessary to determine the bearing capacity of foundation soils at no additional cost to the Owner.

2.9 DESIGN

A. The design provided by the Contractor and prepared by their Wall Design Engineer shall consider the internal and local stability of the reinforced soil mass and shall be in accordance with acceptable engineering practice and these specifications.

B. The Wall Design Engineer shall confirm that the global stability limit states of sliding, overturning, and the allowable bearing pressure on foundation soil(s) have not been exceeded for the design conditions. Minimum factors of safety for design of permanent conditions are as follows:

Overturning	2.0
Sliding	1.5
Bearing Pressure	2.0

C. Where other site development features are to be installed adjacent to walls by the Contractor, the design of the wall system shall be developed to accommodate the potential for geotextile penetrations, such as fence and/or guardrail posts.

D. The Wall Design Engineer shall incorporate headwalls, lintels, or other structural systems in the segmental retaining wall to provide pipe penetrations in the locations indicated on the plans. Exposed portions of the structural members shall have color and texture similar to the block selected by the Owner.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Owner is responsible for verifying that the Contractor meets all the requirements of the specification. This includes all submittals for materials and design, qualifications, and proper installation of wall system.

B. Contractor's field construction supervisor shall have demonstrated experience and be qualified to direct all work at the site.

3.2 EXCAVATION

A. Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted infill material, or as directed by the Owner, at the Contractor's expense.

B. Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation and/or adjacent structure or utility support, if required, is the design and installation responsibility of the Contractor.

C. Slope or shore excavation as necessary for safety and for conformance with applicable OSHA requirements.

3.3 FOUNDATION PREPARATION

A. Following the excavation, the foundation soil shall be examined by the Owner to assure actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting the required strength shall be removed and replaced with infill soils, as directed by the Owner.

B. Foundation soil shall be proof rolled or otherwise compacted to 95% modified Proctor density (ASTM D 1557) and inspected by the Owner prior to placement of leveling pad materials.

3.4 LEVELING PAD CONSTRUCTION

A. Leveling pad shall be placed as shown on the construction drawings with a minimum thickness of 6 inches. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lower most SRW Unit.

B. Soil leveling pad material shall be compacted to provide a firm, level, bearing surface on which to place the first course of units. Well-graded sand can be used to smooth the top 1/2 to 1/4 inch of the leveling pad. Compaction will be with mechanical plate compactors to achieve 95% of maximum modified Proctor (ASTM D 1557) density.

3.5 SRW UNIT INSTALLATION

A. All SRW units shall be installed at the proper elevation and orientation as shown on the wall profiles and details on the construction plans or as directed by the Owner. The SRW units shall be installed in general accordance with the manufacturer's recommendations. The specifications and drawings shall govern in any conflict between the two requirements.

B. First course of SRW units shall be placed on the leveling pad. The units shall be leveled side-to-side, front-to-rear and with adjacent units, and aligned to ensure intimate contact with the leveling pad. The first course is the most important to ensure accurate and acceptable results. No gaps shall be left between the front of adjacent units. Alignment may be done by means of a string line or offset from base line to the back of the units.

C. Clean all excess debris from top of units and install next course.

D. Insert two connection pins through pinholes of each upper course unit into receiving slots in the lower course units. Pins shall be fully seated in the pin slot below. Push units forward to remove any looseness in the unit-to-unit connection and then check alignment. Check level and alignment of the units.

E. Layout of curves and corners shall be installed in accordance with the plan details or in general accordance with SRW manufacturer's installation guidelines. Walls meeting at corners shall be interlocked by overlapping successive courses.

F. Repeat procedures to extent of wall height.

G. The wall face cant (batter) shall not differ more than $\pm$ 2 degrees from that specified.

3.6 GEOSYNTHETIC REINFORCEMENT PLACEMENT

A. All geosynthetic reinforcement shall be installed at the proper elevation and orientation as shown on the wall profiles and details on the final construction plans or as directed by the Owner.

B. At the elevations shown on the final plans, the geosynthetic reinforcement shall be laid horizontally on compacted infill and on top of the concrete SRW units. Embedment of the geosynthetic in the SRW units shall be consistent with SRW manufacturer's recommendations. Correct orientation of the geosynthetic reinforcement shall be verified by the Contractor to be in accordance with the geosynthetic manufacturer's recommendations. The highest strength direction of the geosynthetic must be perpendicular to the wall face.

C. Geosynthetic reinforcement layers shall be one continuous piece for their entire embedment length. Overlap of the geosynthetic in the design strength direction (perpendicular to the wall face) shall not be permitted.

D. Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum of 6 inches of backfill is required prior to operation of tracked vehicles over the geosynthetic. Turning should be kept to a minimum. Rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds (less than 5 mph).

E. The geosynthetic reinforcement shall be in tension and free of wrinkles prior to placement of soil fill. The nominal tension shall be applied to the reinforcement and secured in place with staples, stakes or by hand tensioning until reinforcement is covered by six inches of fill.

3.7 DRAINAGE MATERIALS

A. Drainage aggregate shall be installed to the line, grades, and sections shown on the final plans. Drainage fill shall be placed to the minimum thickness shown on the construction plans between and behind units.

B. Drainage collection pipes shall be installed to maintain gravity flow of water outside the reinforced soil zone. Unless shown otherwise on the plans, drainage collection piping shall daylight into a storm sewer manhole or along a slope at an elevation lower than the lowest point of the pipe within the aggregate drain.

3.8 BACKFILL PLACEMENT

A. The reinforced backfill shall be placed as shown in the construction plans in the maximum compacted lift thickness of 10 inches and shall be compacted to a minimum of 95% of modified Proctor density (ASTM D 1557) at a moisture content within 2% of optimum. The backfill shall be placed and spread in such a manner as to eliminate wrinkles or movement of the geosynthetic reinforcement and the SRW units.

B. Backfill placement shall commence at the back of the wall and progress towards the retained material.

C. Only hand-operated compaction equipment shall be allowed within 3 feet of the front of the wall face. Compaction within the 3 feet behind the wall face shall be achieved by at least three (4) passes of a lightweight mechanical tamper, plate, or roller.

D. At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing to direct water runoff away from the wall face.

E. At completion of wall construction, backfill shall be placed level with final top of wall elevation. If final grading, paving, landscaping, and/or storm drainage installation adjacent to the wall is not placed immediately after wall completion, temporary surface drainage shall be provided to ensure water runoff is not directed at the wall nor allowed to collect or pond behind the wall until final construction adjacent to the wall is completed.

3.9 SRW CAPS

A. SRW caps shall be properly aligned and attached to underlying units with a suitably flexible, high-strength concrete adhesive. Rigid adhesives or mortar will not be accepted.

B. Caps shall overhang the top course of units by 3/4 to 1 inch. Slight variation in overhang is allowed to correct alignment at the top of the wall.

3.10 CONSTRUCTION ADJACENT TO COMPLETED WALL

A. The Contractor is responsible for ensuring that construction adjacent to the wall does not disturb the wall or place temporary construction loads on the wall that exceed design loads, including loads such as water pressure, temporary grades, or equipment loading. Heavy paving or grading equipment shall be kept a minimum of three feet behind the back of the wall face. Contractor to ensure water runoff is directed away from the wall structure until final grading and surface drainage collection systems are completed.

END OF SECTION

SECTION 32 32 23

SEGMENTAL RETAINING WALLS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The conditions and general requirements of the Contract, Division 0 and applicable parts of Division 1, apply to the work under this Section.

B. All references to products by manufacturer, trade name or performance Specifications bearing the notation "or approved equal" shall be as determined by the Landscape Architect and the City.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide all labor, equipment, implements and materials required to furnish, install, construct and perform all site improvements complete as shown on the Drawings and specified herein.

B. To be included, but not limited to the following:

1. Precast Unit Block Retaining Walls

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 02 41 00 – Site Preparation and Demolition
2. Section 31 00 00 – Earthwork – Clearing, Excavation, Filling, and Grading
3. Section 33 00 00 – Utilities

1.3 JOB CONDITIONS

A. Start of work under this Section shall constitute acceptance of the foundation conditions to which this work is to be applied. Any defects in work resulting from such conditions shall be corrected under this Section, at no extra cost to the Owner.

B. Maintain sub-base in satisfactory condition and properly drained until surface improvement is placed.

1.4 SUBMITTALS

A. Shop drawings and samples

1. Provide complete Shop Drawings and/or samples and catalog cuts for all items called for on the Drawings and as specified and in accordance with applicable requirements under Division 1.
2. Do not order materials or begin installation of work of this Section until Owner approval of submittals of all products has been obtained.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened and undamaged packages with labels legible and intact.

B. Store materials in unopened packages in a manner to prevent damage from the environment and construction operations.

C. Handle in accordance with manufacturer's instructions.

D. The Contractor shall be solely responsible for all materials stored on the site once delivered. Any materials left unsecured at the job site shall be solely at the contractor’s own risk.

PART 2 - PRODUCTS

2.1 PRECAST UNIT BLOCK WALLS

A. Precast Unit Block Retaining Wall shall be high-strength precast interlocking concrete block units with a tumbled finish, available in a range of sizes to form a semi-random pattern as shown on (or similar to) the Drawings:

1. Mosaic Retaining Wall System by VERSA-LOK® Retaining Wall Systems, 6348 Hwy. 36 Blvd, Suite 1, Oakdale, MN 55128 (651-770-3166);
2. Or Approved Equal.

B. Adhesive shall be supplied by the approved wall system manufacturer specifically for the wall systems.

C. All walls in this section are expected to be under 2’-6” in height.

1. Should field conditions necessitate a wall above 2’-6” in exposed height, detailed engineering of walls over 2’-6” in height to be provided, as recommended by the Manufacturer, stamped by a Professional Engineer (Structural) registered in the Commonwealth of Massachusetts at Contractor's Expense.

D. Color to be selected by Landscape Architect and Owner from full range of manufacturer’s color options.

E. Provide PVC subdrains and weeps as shown on the Drawings and as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PRECAST UNIT BLOCK WALLS

A. Install per manufacturer’s instructions and according to Drawings including any tie-backs or filter fabric.

B. Submit Manufacturer’s shop drawings for review and approval before proceeding.

C. Copings shall match the wall system and shall be installed in accordance with the Manufacturer's instructions.

D. Construct a 5' sample section of wall for approval by Landscape Architect before continuing with construction.

3.2 GRADE STAKES

A. Install and maintain grade stakes, as directed. All subgrades must be approved before base course construction.

3.3 FINISH GRADES

A. The words "finish grades" as used herein mean the required final grade elevations.

END OF SECTION

SECTION 32 33 00

SITE FURNISHINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 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. Flagpole with Downlight (25’ height);

1.3 DEFINITIONS

A. The following items are included herein and shall mean:

1. S.S.H.B. - Standard Specifications for Highway and Bridges, the Commonwealth of Massachusetts, Department of Public Works, latest edition.
2. A.S.T.M. - American Society for Testing and Materials. The following standard specifications are applicable to the associated items as listed.
3. A36...Steel
4. A153...Zinc Coating (hot-dip) on hardware
5. A307...Carbon Steel bolts 66000 psi tensile
6. CPSC - Consumer Product Safety Council.
7. ADA - Americans with Disabilities Act and its current regulations.
8. AWS: American Welding Society
9. SSPS: Steel Structures Painting Council

1.4 SUBMITTALS AND SHOP DRAWINGS

A. Submit four (4) paper copies or (1) digital copy of complete shop drawings, product literature, catalog cuts and/or samples for all items indicating material characteristics, fabrications, details of construction, connections and relationship with adjacent construction, called for on the Drawings and as specified and in accordance with applicable requirements under Division.

B. Take field measurements prior to preparation or shop drawings and fabrication. Allow sufficient time for shop drawing review and approval, before fabricating or ordering.

C. Do not order materials or begin installation of Work of this Section until Owners / Landscape Architects approval of submittals has been obtained. Delivered materials shall closely match approved samples.

1.5 SAMPLES

A. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.

B. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variation expected.

1.6 PRODUCT LITERATURE

A. For each product or material used, submit manufacturer's product data, including installation instructions, use, limitations and recommendations.

1.7 QUALITY ASSURANCE

A. Comply with all applicable codes, ordinances, and regulations. Provide products of acceptable manufacturer's which have been in satisfactory service in similar conditions for three years. Use experienced installers.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened and undamaged packages and containers with labels legible and intact.

B. Store and handle materials in accordance with manufacturer's instructions. Prevent damage and deterioration of products from the environment and construction operations.

C. Handle in accordance with manufacturer's instructions.

D. The Contractor shall be solely responsible for all materials stored on the site once delivered. Any materials left unsecured at the job site shall be solely at the contractor's own risk.

1.9 JOB CONDITIONS

A. Examine all surfaces to receive site improvements to see that they are in proper condition to receive the work specified. Report to the Landscape Architect in writing all unacceptable areas. All defects resulting from use of accepted surfaces shall be corrected by the appropriate Contractor at no additional expense to the Owner.

B. Start of Work under this Section shall constitute acceptance of the site conditions to which this Work is to be applied. Site preparation shall be of proper approved quality. Any defects in Work resulting from such conditions shall be corrected under this Section, at no extra cost to the Owner.

C. Environmental Requirements: Contractor shall not Work on or with soils when they are dry, wet, or frozen. Field Test: Form soil in palm of hand; if soil retains shape and crumbles upon touching, then it may be worked (if it will not retain its shape, it is too dry; if it does not crumble, it is too wet). Landscape Architect shall be final authority on condition of soil.

1.10 WARRANTIES

A. Attention is directed to provisions of the CONDITIONS OF THE CONTRACT and applicable parts of Division 1 regarding guaranties and warranties.

B. Manufacturers shall provide their standard guaranties for Work specified in the Section. However, such guaranties shall be in addition to and not in lieu of all other liabilities which manufacturers and Contractor may have by law or by other provisions of the Contract Documents.

PART 2 - PRODUCTS

2.1 FLAGPOLE (25’ HEIGHT)

A. Flagpole shall be a ground set tapered aluminum pole with an exposed height of 25 feet as noted in the Plans. The top diameter shall be 3.5 inches and the butt diameter shall be 6 inches. Manufacturer's information to be submitted to Landscape Architect for approval.

B. Flagpole shall have an internal counter weight and locking cleat. Counter weight information to be submitted to Landscape Architect for approval.

C. Flagpole shall have a single sheave truck, cast aluminum revolving, non-fouling, internal halyard truck.

D. Flagpole shall have a 1/8” x 7x19 Mil-C-5424 stainless steel aircraft cable with 2” diameter steel counterweight.

E. Flagpole shall have a gearless, self locking direct drive winch with six tumbler cylinder lock.

2.2 FLAGPOLE DOWN LIGHT

A. Flagpole LED Down Light to be by Eagle Mountain Flag & Flag Poles Ph: (800) 385-5605; Model Number DM3K-IHNR or Approved Equal.

B. Light to be designed for internal halyard rope based flagpoles.

C. Light source to be LED with 723 delivered lumens. Color Temperature to be 3000K or as approved by Owner's Representative.

D. Luminaire to have integrated photocell.

E. Luminaire to have 360 degree light coverage and must be capable of fully illuminating flag.

F. Down Light to be powered using an Above-Ground Power Supply for Dome Downlight by the same Manufacturer (Eagle Mountain Flag & Flag Poles, Item code DDLAGDRIVER, or Approved Equal). Power Supply to be mounted in the Electrical Cabinet.

G. Order additional lead wire as needed for connecting to electrical cabinet as determined by electrical contractor.

PART 3 - EXECUTION

3.1 FLAGPOLE (25’ HEIGHT)

A. Install per drawings and Manufacturer’s installation instructions.

B. Contractor to have footing inspected and approved by Massachusetts Registered Structural Engineer.

3.2 FLAGPOLE DOWN LIGHT

A. All electrical work shall comply with all applicable codes and regulations, and shall be reviewed by the Town of North Reading Inspectional Services Department.

B. Install all lighting and conduits per manufacturer’s directions and in accordance with all applicable state, local, federal, and environmental regulations and codes.

C. Install Power Supply within the building or in an adjacent in-ground handhole (if permitted by manufacturer) as required. Review proposed location with Owner’s representative.

D. Contractor to touch up any scratches and all mars to surfaces and finishes of flagpole or downlight.

3.3 CLEANING

A. Waste disposal: Comply with all regulations regarding handling, storage, and disposal of all hazardous materials and waste. Consult local agencies or disposal companies for individual instructions and requirements. Improper disposal of paint and their related materials is illegal and may result in large fines. Please comply with all regulations and minimize waste whenever possible.

B. Perform cleaning during installation and upon completion of paving work. Remove from site all excess materials, debris, and equipment.

3.4 STANDARDS OF COMPLETION

A. Upon completion, the contractor(s) shall remove and properly dispose of all construction debris, surplus materials, and empty containers, and leave the site in a condition acceptable to the Owner.

END OF SECTION

SECTION 32 80 00

IRRIGATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The Work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

B. All references to products by manufacturer, trade name or performance Specifications bearing the connotation "or Approved Equal" shall be as determined by the Landscape Architect and the Owner, per MGL c. 30 s. 39M, part b, criteria 1.

C. Coordinate work of this Section with other underground utilities and with trades responsible for their installation. Refer to respective Drawings and Specification sections pertaining to other work.

D. It is the Contractor’s obligation for blowout, maintenance and start-up of system for the first year; provide a walkthrough review with the Department of Public Works before maintenance is handed over to the Owner.

1.2 DESCRIPTION OF WORK

A. Perform all labor, equipment, implements and materials required to furnish, install, construct and perform all irrigation site improvements complete as shown on the Drawing Notes and specified herein.

B. All necessary changes to the Drawings to avoid any obstacles shall be made by the Contractor with the approval of the Owner’s Representative.

C. Trench excavation, back filling and bedding materials, together with the testing of the completed installation shall be included in this work.

D. The work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work, whether the same may have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

E. The irrigation system to be installed shall be an extension of the existing turf and landscape irrigation system supplied from municipal water. The system shall be designed for a flow rate (GPM) and dynamic pressure (PSI) as are available from the existing connection; inform Owner's Representative and Landscape Architect promptly if flow or pressure is insufficient.

F. The principal work of this Section includes, but may not be limited to the following:

1. Automatic Irrigation System (Scope shown or described on Drawings, if applicable, or 100% coverage of all lawn areas, tree pits, and plant beds if not described);
2. One (1) Year Warranty;
3. 90 calendar days' maintenance of irrigation system;
4. As-Built Record Drawings as well as Operating & Maintenance Manual generation, in accordance to these specifications.

G. Related work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 32 10 00 – Bases, Ballasts, and Paving
2. Section 32 90 00 – Planting
3. Section 33 10 00 – Water Utilities

1.3 ORDINANCES, PERMITS AND FEES

A. The Work under this Section shall comply with all ordinances and regulations of authorities having jurisdiction.

B. The Contractor shall obtain and pay for any and all permits, tests and certifications required for the execution of Work under this Section.

C. Furnish copies of Permits, Certifications and Approval Notices to the Owner's Representative prior to requesting payment.

D. The Contractor shall include in their bid any charges by the Department of Public Works, Utility Company, or other authorities for work done by them and charged to the Contractor.

1.4 SUBMITTALS & PRODUCT LITERATURE

A. Allow 2 weeks from original submittal to Landscape Architect and Owner's Representative for municipal review of all submittals and plans.

B. The Contractor shall provide copies of proposed irrigation layout, product specification sheets on all proposed equipment to be installed to the Owner's Representative for approval.

1. Work on the irrigation system may not commence until proposed plan has been approved by the Landscape Architect and product sheets are submitted and approved.
2. Submittals shall be marked up to show proper nozzles, sizes, flows, etc.
3. Submittal package shall also include a full, detailed irrigation plan. The irrigation plan shall be measured, and shall show all coverage arcs of spray and sprinkler heads.

C. Manufacturer's printed information describing irrigation materials:

1. Sprinkler Heads
2. Valves: Manual and Automatic
3. Controllers (if needed)
4. Valve Boxes
5. Pipes and Fittings
6. Wire and Connectors
7. Quick Coupling Valves
8. Rain Sensor (if needed)
9. Backflow Preventer
10. Miscellaneous Materials

D. Record Drawing

1. Provide complete irrigation system Record Drawing/As-Built Plan on reproducible base supplied by the Owner's Representative. The Plan shall clearly show and label each zone for controls and maintenance. (See 1.12.B)
2. Drawing shall call out materials, have a legend, numbered valves, and show details of valve assemblies, swing joints, risers, valve boxes, and typical trench section.

3. All valve boxes shall be referenced by distance from a minimum of two permanent points in a triangular fashion.

E. Project Record Documents:

1. The Contractor shall provide and keep up-to-date a complete Record Set of Drawings of the system as the project proceeds. Drawings shall be on a reproducible base, supplied by the Owner's Representative. Drawings shall be corrected daily, showing every change from the original Drawings and Specifications. Prints for this purpose may be obtained from Owner's Representative at cost.
2. Record Drawings shall specify and exactly locate sprinkler type; pop up height and nozzle for each sprinkler installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controller(s), rain sensor(s), air vacuum relief valves, flushing valves, quick coupling valves, water meters, back flow prevention device and all other equipment shall be indicated on the drawings. All wire routing, wire size and splices shall be indicated. Main line pipe and wire route shall have two (2) distinctly different graphic symbols (line types). Drawing Set shall have a legend and valves shall be numbered.
3. This redlined record set of drawings shall be kept at job site and shall be used only as a record set. This redlined set of documents shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed.
4. On or before the date of final field observation, deliver corrected and completed AutoCAD computer plots of "record drawings" on vellum and AutoCAD electronic files on disk to Owner's Representative as part of contract closeout. Delivery of plots will not relieve Contractor of the responsibility of furnishing required information omitted from the prints.

F. At the end of each segment of the project the contractor shall submit the following to the Owner's Representative.

1. Plumbing permits: If none required, so state.
2. Material approvals.
3. Pressure line tests: By whom approved and date.
4. Materials furnished: Recipient and date.

1.5 QUALITY ASSURANCE

A. Installer: A firm which has at least five (5) years experience in work of the type and size required by this Section and which is acceptable to the Owner's Representative.

B. References: The Contractor must supply three references for work of this type and size with their bid including names and phone numbers of contact person(s).

C. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:

1. American Society for Testing & Materials (ASTM)

a. ASTM: A536 Ductile Iron Castings
b. ASTM: D1784 Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
c. ASTM: D1785 PVC Plastic Pipe, Schedules 40, 80, and Cl200.
d. ASTM: D2464 Threaded PVC Plastic Pipe Fittings, Schedule 80.
e. ASTM: D2466 PVC Plastic Pipe Fittings, Schedule 40.
f. ASTM: D2564 Solvent Cements for PVC Plastic Piping Systems.
g. ASTM: B43-98 Brass pipe.
h. ASTM: B88-99 Seamless Copper Water Tube
i. ASTM: B828-00 Soldered Copper Joints.
j. ASTM: F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
k. ASTM: D2737-99 Polyethylene (PE) Pressure rated tube.

2. National Plumbing Code (NPC)
3. National Electric Code (NEC)
4. National Sanitary Foundation (NSF)
5. American Society of Agricultural Engineers (ASAE)
6. Underwriters Laboratories, Inc. (UL)
7. Occupational Safety and Health Regulations (OSHA)

1.6 TESTS

A. Observation: The Owner’s Representative will be on site at various times to insure the system is being installed according to the Specifications and Drawings.

B. Coverage Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Owner's Representative. Demonstrate to the Owner's Representative that all irrigated areas are being adequately covered, and that there is no significant overspray onto pavements, walks, or structures. Furnish and install materials required to correct inadequacies of coverage due to deviations from the Drawings or where the system

has been willfully installed when it is obviously inadequate or inappropriate without bringing it to the attention of the Owner. (See Part 3 - Execution).

C. The Owner’s Representative shall be notified 48 hours in advance for observations.

D. During final observation, the contractor shall be responsible for having two-way communication and sufficient personnel to provide instantaneous communication between the observation area and the controller for the system.

1.7 GUARANTEE

A. The Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities that the Contractor may have by law.

B. In addition to the manufacturers guarantees the Contractor shall warrant the entire irrigation system, both parts and labor for a period of one (1) year from the date of acceptance by the Owner.

C. As part of the one-year warranty the Contractor shall perform the first year-end winterization and spring start-up for the irrigation system.

D. Should any problems develop within the warranty period because of inferior or faulty materials or workmanship, they shall be corrected to the satisfaction of the Owner’s Representative at no additional expense to the Owner.

E. A written warranty showing date of completion and period of warranty shall be supplied upon completion of each segment of the project.

1.8 COORDINATION

A. The Contractor shall at all times coordinate his work closely with the Owner’s Representative to avoid misunderstandings and to efficiently bring the project to completion. The Owner’s Representative shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the change is made. The Contractor shall also coordinate his work with that of his sub-contractors.

B. The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work, workmen or sub-contractors. Repairing of such damage shall be done by the Contractor who installed the work, as directed by the Owner's Representative.

1.9 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Contractor shall include in their Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (The Owner's Representative office shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).

B. Upon completion of work and prior to application for acceptance and final payment, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE CLAPP PARK IRRIGATION SYSTEM, shall be submitted to the Owner's Representative office per 01 78 00 Closeout Documentation. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:

1. Table of Contents
2. Written description of Irrigation System.
3. System drawings:

    a. One (1) copy of the original irrigation plan;
    b. One (1) copy of the Record Drawing;
    c. One (1) reproducible of the Record Drawing;
    d. One (1) copy of the controller valve system wiring diagram

4. Listing of Manufacturers
5. Manufacturers' data where multiple model, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.

    a. "APPROVED" submittals of all irrigation equipment;
    b. Operation:
    c. Maintenance: including complete troubleshooting charts.
    d. Parts list.
    e. Names, addresses and telephone numbers of recommended repair and service companies. A copy of the suggested "System Operating Schedule" which shall call out the controller program required (zone run time in minutes per day and days per week) in order to provide the desired amount of water to each area under "no-rain" conditions.

f. Winterization and spring start-up procedures.
g. Guarantee data.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in manufacturer's original unopened and undamaged packages with labels legible and intact.

B. Acceptance at Site: Verify that delivered materials conform to specifications and approved submittals.

C. Store materials in unopened packages in a manner to prevent damage from the environment and construction operations.

D. Handle in accordance with manufacturer's instructions.

1.11 PROCEDURE

A. Notify all city departments and/or public utility owners concerned, of the time and location of any work that may affect them. Cooperate and coordinate with them in the protection and/or repairs of any utilities.

B. Provide and install temporary support, adequate protection and maintenance of all structures, drains, sewers, and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed or reconstructed as directed by the Architect.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system (exclusive of the portions of the existing system to remain). All material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.

B. No material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Owner's Representative.

C. System shall be design/build, and shall provide 100% coverage of all lawn and planting beds indicated on the Planting Plan, without overspray onto paths, pavements, walls, or structures. Pop-up spray heads shall be used for lawn areas; drip irrigation shall be used in planting beds.

D. Provide initial irrigation design plan for approval before commencing construction or installing any pavements; irrigation plan shall include all proposed sleeves, valves, lines, heads, and spray areas, as well as control box location.

2.2 POINT OF CONNECTION

A. The mechanical and electrical points of connection for the irrigation system shall be an appropriate extension of the existing system as provided or arranged by the Contractor in compliance with all applicable Codes.

2.3 PVC IRRIGATION PIPE

A. All pipe shall bear the following markings: Manufacturer's name, nominal pipe size, schedule or class, pressure rating in psi, and date of extrusion.

B. All pipe in sizes 2-1/2 inches and smaller shall be PVC, Class 200, Type 1120, SDR 21, Solvent-Weld PVC, conforming to ASTM No. D2241 as manufactured by Certainteed, Cresline, JM or equal.

C. The pipe insertion mark shall be visible to show the proper depth into spigot.

D. Copper Lines shall be used from street connection, through water cabinet, to irrigation controller; PVC pipe may be used for irrigation components downstream of irrigation control box.

2.4 BRASS PIPE AND FITTINGS

A. Brass pipe shall be 125lb. cast bronze, ground joint pattern, threaded, ASTM B43-98.

B. Brass fittings shall be cast bronze, screwed, 125lb. Class.

2.5 PVC PIPE SLEEVES

A. All pipe sleeves beneath non-soil areas shall be PVC, Class 160 water pipe as manufactured by Certainteed, Cresline, JM or equal. Minimum sleeve size to be 3”.

2.6 WIRE CONDUIT

A. Conduit for wiring beneath non-soil areas shall be PVC, SCH-40 conduit with solvent-weld joints, as manufactured by Certainteed, Cresline, JM or equal.

B. Sweep ells shall be standard electrical type PVC schedule 40 long sweep elbows. Cap sweep ell with tri-plug with the ring for securing nylon pull rope.

C. Conduit for above ground wiring to rain sensors or controllers shall be galvanized, rigid metallic conduit.

2.7 PVC IRRIGATION FITTINGS

A. Fittings for solvent weld PVC pipe, 2-1/2 inch and smaller in size, shall be Schedule 40 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or equal.

B. Fittings shall bear manufacturer’s name or trademark, material designation, size, and applicable I.P.S. schedule.

C. All PVC threaded connections in and out of valves shall be made using Schedule 80 toe nipples and Schedule 40 couplers or socket fittings. Schedule 40 threads will not be approved for installation.

D. PVC solvent shall be NSF approved, for Type I and Type II PVC pipe, and Schedule 40 and 80 fittings. Cement is to meet ASTM D2564 and FF493 for potable water pipes. PVC solvent cement shall be Rectorseal Gold, IPS Weld-ON 711, Oatey Heavy Duty Cement or equal, and shall be used in conjunction with the appropriate primer. Primer shall be NSF approved, and formulated for PVC and CPVC pipe applications. Primer is to meet ASTM F 656. Primer shall be Rectorseal Jim PR-2, IPS Weld-ON P-68 Clear, Oatey Clear Primer for PVC and CPVC, or equal.

E. All nipples to be schedule 80 PVC.

2.8 POLYETHYLENE IRRIGATION PIPE

A. Lateral piping 1-1/4 inch and smaller in size as indicated on the drawings may also be installed with polyethylene (PE3408) pipe, SDR 15, Class 100, Type III, Grade 3, Class C conforming to ASTM D2239, with a minimum pressure rating of 100 psi as manufactured by Oil Creek or equal. Polyethylene pipe shall only be used in landscape areas.

2.9 POLYETHYLENE IRRIGATION FITTINGS

A. Fittings for polyethylene pipe shall be insert PVC or Nylon type fittings. Fittings shall conform to NSF standards and be attached with two (2) dog-eared stainless steel clamps. Clamps shall be as manufactured by Oetiker or Approved Equal.

B. Supply only pipes and fittings that are marked by the manufacturer with the appropriate ASTM designations and pressure ratings and are free from cracks, wrinkles, blisters, dents or other damage. Fittings shall be per ASTM D2609 as manufactured by Dura, Lasco or Approved Equal.

2.10 SPRAY SPRINKLERS

A. Full and part circle pop up spray sprinklers shall be pressure regulating (30-psi), plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the drawing and in the legend. Pop-up height shall be 6 inches for turf and 12 inches for ground cover, shrubs and annual beds.

B. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Hunter Industries, model INST-06-CV for turf and INST-12 CV for shrubs or Approved Equal.

2.11 SMALL/MEDIUM ROTARY SPRINKLERS

A. Small/medium rotary sprinklers shall be gear-driven, rotary type heads, designed for in-ground installation with integral check valves and in-riser flow shut-off capability. Sprinkler shall be capable of covering a 25-44 foot radius and flow range of 0.9-7.0 gpm at 50-55 pounds per square inch of pressure. Sprinklers shall have a one hundred percent warranty for two years minimum against defects in workmanship.

B. The nozzle assembly shall elevate minimum four inches when in operation and retraction shall be achieved by a stainless steel spring. Riser assembly shall be plastic. A nozzle wiper seal shall be included in the sprinkler for continuous operation under the presence of sand and other foreign material.

C. All sprinkler parts shall be removable through the top of the unit through the removal of a heavy-duty threaded cap. The sprinkler shall have a three quarter-inch (3/4") IPS water connection on the bottom of the sprinkler.

D. Sprinklers shall be manufactured by Hunter Industries model I20-ADV or Approved Equal.

Approved Performance Chart (25’ Spacing):

Model	Pressure	Arc	Nozzle	Flow	Radius
Hunter I20-ADV	50psi	90 Deg.	.75SR	0.75	25’
Hunter I20-ADV	50psi	180 Deg.	1.5SR	1.5	25’
Hunter I20-ADV	50psi	360 Deg.	3.0SR	3.0	25’

Approved Performance Chart (35’ Spacing)

Model	Pressure	Arc	Nozzle	Flow	Radius
Hunter I20-ADV	50psi	90 Deg.	2.0	2.0	38’
Hunter I20-ADV	50psi	180 Deg.	4.0	4.2	41’
Hunter I20-36V	50psi	360 Deg.	8.0	6.8	44’

2.12 ELECTRIC CONTROL VALVES

A. Electric control valves shall be one-inch remote control, diaphragm type, fiber-glass or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 200 psi pressure rating.

B. Valves shall be manufactured by Rain Bird model PEB, Hunter Industries model ICV or Approved Equal.

2.13 VALVE BOXES

A. All valve boxes shall be manufactured from unformed resin with a tensile strength of 3,100-5,500 psi conforming to ASTM D638. All boxes shall be green in color. Covers shall be green in color unless otherwise specified.

B. Valve boxes for single 1 inch electric valves, isolation valves and quick coupling valves shall be 10-inch round valve boxes with metal detection and bolt down covers

C. Valve boxes for dual electric valves shall be 12-inch standard valve boxes with metal detection and bolt down covers. When multiple electric valves are installed in the same area, they are to be installed two (2) valves per box in a 12-inch standard box.

D. Covers shall be bolted down.

E. Valve boxes for wire splices shall be 10 inch round valve boxes with detectable disks. All splices shall be in separate valve boxes and not included with isolation valves. 220 volt splices shall have black lids, 24 volt splices shall have gray lids.

F. Valve box extensions shall be provided and installed as required for proper box depth. Valve box extensions shall be made by the same manufacturer.

G. Valve boxes shall be manufactured by Pentek, Carson Specification Grade, NDS Pro Series or Approved Equal.

2.14 AUTOMATIC CONTROLLER (IF REQUIRED)

A. Existing Controller shall be reused if suitable to the project. If a replacement controller is required, the following specifications shall be in effect:

1. Controller shall be electronic in construction with capability of up to 10 hour run times per zone in increments of 1 or 10 minutes. Controllers to have minimum four independent programs, auto/off switch and be capable of manual, semi-automatic and automatic operation. Controller shall have water budgeting feature, cycle and soak feature, sensor input terminal, locking, weather resistant cabinet and internal transformer. Terminal strip connection shall be easily accessible. The controller shall be U.L. listed, 120 volt, 60 Hertz, A.C. type.
2. Controller shall be as manufactured by Rain Bird model ESP-12LXM, Hunter Industries model ICC-1200PL or Approved Equal.
3. Station quantity shall be minimum of 10.

2.15 QUICK COUPLING VALVES

A. The valve body shall be of cast brass construction with a working pressure of 125 psi. The valve seat disc plunger body shall be spring loaded so that the valve is normally closed under all conditions when the key is not inserted.

B. The top of the valve body receiving the key shall be equipped with ACME threads and smooth face to allow the key to open and close the valve slowly. The quick coupling valve shall be equipped with a vinyl cover.

C. The valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.

D. Keys shall be ACME with 1-inch male thread and 3/4-inch female thread at the top.

E. Contractor shall provide two (2) keys for quick couplers and two (2) 1-inch x 3/4-inch swivel hose ells.

F. Quick coupling valves, keys and swivels shall be manufactured by Hunter Industries, model HQ-44RC-AW, HK-44 and HS-1 or Approved Equal.

2.16 WIRE

A. All valve control wire shall be minimum #14-awg, common #12-awg, single strand, solid copper, UL- approved direct burial AWG-U.F. 600V and shall meet all state and local codes for this service. Individual wires must be used for each zone valve. Common wire shall be white in color, control wire for spray and rotor zones shall be red in color, and spare wires, installed where applicable, shall be blue. White color shall be used for common wire only.

B. In ground wire connections shall be UL listed, manufactured by 3M, model DBY-6 splice kits. All wire splices shall be made in valve boxes, at controller, or at valves.

C. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

2.17 SWING JOINTS

A. Spray sprinklers, small rotary sprinklers and medium rotary sprinklers shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Quick coupling valves to be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double o-ring seals, minimum 315 psi rating and minimum length of 12 inches with brass insert and stabilizer (unless stabilizer is an integral part of the quick coupling valve).

2.18 AUTOMATIC RAIN SENSORE (IF REQUIRED)

A. The existing Rain Sensor shall be reused if suitable to the project. If a replacement sensor is required, the following specifications shall be in effect:

1. Rain sensor shall be plastic in construction with adjustable interruption point, 1/2-inch IPS threads with wireless transmitter. Rain sensor shall be manufactured by Hunter Industries, model WRC, or Approved Equal.
2. Location to be approved in the field with Owner’s Representative and Landscape Architect.
3. Contractor shall provide batteries for the wireless system. Spare parts to be submitted to the Department of Public Works per 2.21.

2.19 CONTROLLER ENCLOSURE (IF REQUIRED)

A. The controller shall be enclosed within the School unless otherwise directed by the Owner and the Landscape Architect.

2.20 COUNTROLLER GROUNDING (IF NEW CONTROLLER REQUIRED)

A. The irrigation controller shall include factory-installed and factory-recommended lightning protection and shall be connected to a 5/8-inch diameter x 10-foot long copper clad grounding rod with minimum #6 AWG, solid, bare copper wire and 4-inch x 96-inch x 0.0625-inch copper grounding plate as outlined below. Minimum 20-foot separation between rod and plate. Minimum 12-foot separation between controller and ground rod. All connections to rod shall be with Cadweld connector as specified. All connections to plates shall be performed by the plate manufacturer (Paige or Approved Equal #182199L) with 25-feet of bare copper wire already attached. Grounding rod is to be covered by a 4-inch round, grated top, plastic valve cover with metal detection and six inches of 4-inch ADS drainage pipe. Plate shall be installed in ground enhancement material. Plate shall be covered with 4-inch plastic grated cover with detection and minimum 36 inches of 4 inch ADS drainage pipe. Ground rod and plate shall be UL listed.

B. Controller shall be grounded to one rod and one plate. The 10-foot rod shall be installed penetrating into the soil to its full length. Plate shall be installed at a 36-inch depth with 50 lbs of Power Set ground enhancement material spread evenly below the plate and 50 lbs spread evenly above the plate in accordance with manufacturer’s requirements. The grounding electrodes shall be installed at least 10 feet from wires connected to the field controllers.

2.21 SPARE PARTS

A. Contractor shall supply the following tools and equipment to the Owner’s Representative before final observation:

1. Two (2) wrenches for disassembling/adjusting each type of sprinkler head.
2. One (1) quick coupler key assembly for every five or fraction thereof of each type of quick coupling valve provided.
3. One (1) of each type of gate valve used in the project.
4. Two (2) of each type sprinkler head and pattern (PC & FC) used.
5. Two (2) of each type nozzle used in the project.

B. Before final observation can occur, all spare parts, tools, and equipment shall be submitted to the Owner (through the Owner's Representative) in a single container, clearly marked with the Project Name and "Irrigation Supplies."

PART 3 - EXECUTION

3.1 GENERAL

A. The irrigation system shall be Design/Build – the Irrigation Contractor shall provide a proposed Irrigation Plan to the Landscape Architect and the Owner's Representative for Approval prior to starting construction.

B. Before work is commenced, hold a conference with the Owner's Representative to discuss general details of the work.

C. Examine all contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Owner's Representative for timely resolution.

D. All work indicated on Drawings shall be provided whether or not specifically mentioned in the Specifications.

E. If there are ambiguities between Drawings and Specifications, and specific interpretation or clarification is not issued prior to bidding, the interpretation or clarification will be made only by Owner's Representative, and Contractor shall comply with the decisions. In the event the installation contradicts the directions given, the installation shall be corrected by Contractor at no additional cost to Owner.

F. Verify dimensions and grades at job site before work is commenced. All obstructions, conflicts, or discrepancies shall be brought to the attention of the Owner's Representative.

G. Make all field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades (landscaping and other site work trades). Project shall be laid out essentially as indicated on the approved Irrigation Plans, making minor adjustments for variations in the planting arrangement. Major changes shall be reviewed with the Owner's Representative prior to proceeding.

H. Coordinate installation of all sprinkler materials, including pipe, to avoid conflict with the trees, shrubs, or other plantings.

I. At all times, protect existing irrigation, landscaping, paving, structures, walls, footings, etc. from damage. Any inadvertent damage to the work of another trade shall be reported at once.

J. Replace, or repair to the satisfaction of the Owner, all existing paving disturbed during course of work. New paving shall be the same type, strength, texture, finish, and be equal in every way to removed paving.

3.2 PIPE AND FITTINGS INSTALLTION

A. Using proper width trencher chain, excavate a straight (vertical) and true trench to a depth as required for pipe invert elevation. Trenching within the protected areas of existing trees shall be hand work only; avoid damage to significant existing roots.

B. In installing irrigation pipe the Contractor shall route the pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, the Contractor shall provide proper root pruning and sealing methods to all roots 1-inch and larger.

C. Loam or topsoil encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the appropriate lines and depths and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.

D. Pipe shall be laid on undisturbed trench bottom provided suitable base is available - no rock larger than 1 inch or sharp edges; if not, excavate 2 inches below pipe invert and provide and install sand base or crushed stone upon which to lay pipe.

E. Back filling shall be accomplished as follows: the first 10 inches of backfill material shall contain no foreign matter and no rock larger than 1 inch in diameter. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with appropriate mechanical equipment. Compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken area, humps, or other irregularities. Frozen material shall not be used for backfill.

F. Do backfilling when pipe is cool. During hot weather cool pipe by operating the system for a short period, or by backfilling in the early part of the morning before the heat of the day.

G. Throughout the guarantee period it will be the responsibility of the Contractor to refill any trenches that have settled due to incomplete compaction.

H. Mainline pipe shall have minimum 22 inches of COVER (excavate to invert as required by pipe size). Lateral pipe shall have minimum 16 inches of COVER for PVC and 12 inches of cover for Polyethylene (excavate to invert as required by pipe size).

I. Cut plastic pipe with handsaw or pipe-cutting tool, removing all burrs at cut ends. All pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's Specifications.

J. Clean bell and spigot ends and make all gasketed joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of lubricant, and wiping off any excess lubricant from each connection. Maximum deflection per joint shall not exceed manufacturer's recommendations.

K. Make all solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow welded joints at least 15 minutes set-up/curing time before moving or handling. When the temperature is above 80º F, allow connections to set minimum 24 hours before pulling or pressure is applied to the system. When temperature is below 80º F, follow manufacturer’s recommendations. Provide and install for expansion and contraction as recommended.

L. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench.

1. At times when installation of the piping is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. All piping which cannot temporarily be joined shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out.
2. Should water enter the trench during or after installation of the piping, no additional piping may be installed or back filled until all water is removed from the trench.
3. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 40º F or below. Pipe installed at temperatures below 40º F shall be removed and replaced at no cost to the Owner.

4. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.

M. Maintain 6-inch minimum clearance between sprinkler lines and lines of other trades. Do not install sprinkler lines directly above another line of any kind.

N. Maintain 1-inch minimum between lines which cross at angles of 45 to 90 degrees.

O. Exercise care when excavating, trenching and working near existing utilities.

P. Pulling of pipe will be allowed provided soil is suitable and specified depth of bury can be maintained.

3.3 ELECTRICAL WIRE CONDUIT INSTALLTION

A. Electrical conduit shall be installed in all non-soil areas, as well as for all above ground wiring where wire passes under or through walls, walks and paving to controllers and rain sensor.

B. Wire shall be laid in same trench as mainline and at pipe invert.

C. Conduit shall extend 18 inches beyond edges of walls and pavement.

3.4 PIPE SLEEVING INSTALLATION

A. Sleeving shall be installed wherever piping is going under a non-soil area. Minimum cover over all sleeving pipe shall be 24 inches.

B. Sleeving shall extend 18 inches beyond edges of walls and pavement.

3.5 VALVE BOX INSTALLATION

A. Furnish and install a valve access box for each electric valve, quick coupling valve, isolation valve, flushing valve, air relief valve and wire splice.

B. All valve access boxes shall be installed on a minimum 4-inch crushed stone base. Finish elevation of all boxes shall be at grade. All crushed stone to be supplied by the Contractor and installed before valve box. Crushed stone shall not be poured into previously installed valve boxes.

3.6 24 VOLT CONTROL VALVE INSTALLATION

A. Control valves shall be installed on a level crushed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and all bolts, screws and wiring accessible through the valve box opening. Valves shall be set in a plumb position with 24-inch minimum maintenance clearance from other equipment.

B. Install at sufficient depth to provide more than 6-inch, nor less than 4-inch cover from top of valve to finish grade.

C. Adjust zone valve operation after installation using flow control device on valve.

3.7 WIRING INSTALLATION

A. Wiring shall be installed along with the main line. Multiple wire bundles shall be cinched together at maximum 12-foot centers using plastic cable cinches and shall be laid beside, and at the same invert as, the irrigation lines. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide and install an additional 8 inches to 12 inches slack at all changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, and all connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box. Each valve shall have a separate wire back to the controller.

B. All wire shall be laid in trenches and shall be carefully back-filled to avoid any damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2 inches layer of sand or stone dust on the bottom before the wires are laid into the trench and back-filled. The wires shall have a minimum of 12 inches of cover. Wire not to be installed that day shall not be laid out.

C. An expansion curl shall be provided and installed within 6 inches of each wire connection to a solenoid and at least every 100 feet of wire length on runs more than 100 feet in length. Expansion curls can be formed by wrapping five (5) turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.

D. Provide and install a common ground wire of white color. No white color shall be used for power wire. Control wire shall be red and spare wiring shall be blue in color.

E. Service wiring in connection with Drawings, manufacturer's instructions, and local codes for 24-volt service. All in-ground wire connections shall be waterproofed with 3M DBY-6 splice kits or Approved Equal. All splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided and installed in splice box-valve box shall be used). Splice locations shall be shown on the Record Drawings.

F. Contractor shall provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

3.8 CONTROLLER INSTALLATION (IF REQUIRED)

A. Contractor to install controller in School building unless otherwise directed by the Landscape Architect and Owner. Contractor to wire valves and rain sensor into controller and set proper program.

B. Wire controller to 120-volt electrical supply provided and installed to the controller locations by licensed electrician.

C. Keys shall be turned over to Owner's Representative.

3.9 CONTROLLER GROUNDING INSTALLATION (IF REQUIRED)

A. Grounding rod shall be driven into the ground its full length within 8 feet of the controller and connected via a Cadweld or Approved Equal connection to #6 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4-inch grated cover as specified, set a minimum of 1-inch below grade, shall be placed over the ground rod and Cadweld or Approved Equal connection for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4-inch ADS or Approved Equal corrugated polyethylene, perforated drainage pipe. Plate shall be installed 36 inches below grade with 50 lbs of Power Set ground enhancement material spread evenly below the plate and 50 lbs of Power Set ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plate shall also be covered with a 4 inch grated cover as specified, set a minimum of 1-inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 36 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe.

B. Grid shall be installed in an irrigated area.

3.10 RAIN SENSOR INSTALLATION (IF REQUIRED)

A. Install rain sensor on light pole, wall, fence post, or other vertical feature, at a location approved in the field by the Landscape Architect and the Owner's Representative. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray.

3.11 SPRINKLER INSTALLATION

A. Spray sprinklers, small rotary sprinklers and medium rotary sprinklers shall be installed flush (perpendicular) to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Sprinklers shall not exceed maximum spacing indicated.

C. Adjust sprinkler zone after installation using flow control device on valve.

3.12 QUICK COUPLING VALVE INSTALLATION

A. Provide and install quick coupling valves at appropriate locations so that no hose used for hand-watering needs to be more than 50 feet in length.

B. Quick coupling valves to be mounted on 1-inch prefabricated PVC unitized swing joint assemblies with integral o-rings, minimum length 12 inches with brass insert and stabilizer as per details.

3.13 CHECK/TEST/START-UP/ADJUST

A. Flushing:

1. After all piping, valves, sprinkler bodies, pipe lines and risers are in place and connected, but prior to installation of sprinkler internals, open the control valves and flush out the system under a full head of water.
2. Sprinkler internals, flush caps and riser nozzles shall be installed only after flushing of the system has been accomplished to the full satisfaction of the Owner's Representative.

3. Contractor shall be responsible for flushing the entire system after installation is complete and will be responsible for any clogged nozzles for ninety (90) days after substantial completion of this portion of the irrigation system.

B. Testing

1. Leakage test: test all lines for leaks under operating pressure. Repair all leaks and re-test.
2. Coverage test: perform a coverage test in the presence of the Owner's Representative (notify Architect at least seven (7) days in advance of scheduled coverage test). Representative will determine if the water coverage is complete and adequate. Readjust heads and/or head locations as necessary or directed to achieve proper coverage.
3. All testing shall be at the expense of the Contractor.

3.14 CLEANING AND ADJUSTING

A. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by the operation of the system for testing.

B. Adjust sprinkler heads, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by mowing operations.

C. Continue sprinkler coverage adjustment as required by settlement, etc., throughout the guarantee period.

D. Each control zone shall be operated for a minimum of 5 minutes and all heads checked for consistency of delivering water. Adjustments shall be made to sprinklers that are not consistent to the point that they match the manufacturer's standards. All sprinklers, valves, timing devices or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

3.15 ACCEPTANCE AND OPERATION BY OWNER

A. Upon completion of the work and acceptance by the Owner, the Contractor shall be responsible for the training of the Owner's Representative(s) in the operation of the system (provide minimum 48 hours written notice in advance of test), including a complete walk-through on the site with the Owner’s Representative and a representative from the Department of Public Works.

B. In addition to the Record Drawings and operational manuals, the Contractor shall furnish copies of all available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system.

C. The Contractor shall be responsible for the first winterization of the system, and the first start-up the following spring. Both winterization and start-up shall be performed in the presence of and with instruction provided to the Owner’s Representative and the Department of Public Works; provide minimum 48 hours written notice in advance of the test.

D. The Contractor shall guarantee all parts and labor for a minimum period of one (1) year from date of acceptance.

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SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The conditions and general requirements of the Contract, Division 0 and applicable parts of Division 1, apply to the work under this Section.

B. Contractor shall comply with all laws, regulations, and quarantines for agricultural and horticultural products.

1.2 DESCRIPTION OF WORK

A. Work Included: The work of this Section consists of the provision of all materials, labor, equipment and the like for the complete execution of all lawn establishment by sodding and related items as indicated on the Drawings and/or as specified herein.

B. Work includes but is not limited to the following:

1. Topsoil (loam borrow), fine grading and loaming;
2. Plant Materials;
3. Soil additives;
4. Lawn Seed Mix;
5. Bark Mulch;
6. Watering Bags for Tree Plantings;
7. Maintenance, watering, and protection of plantings until final acceptance.

C. Related Work: Examine all other Sections of the Specifications and all Drawings for the relationship of the work under this Section and the work of other trades. Cooperate with all other trades and coordinate all work under this Section therewith.

D. Related items include but are not limited to work under the Sections listed below:

1. Section 01 57 00 – Environmental Protections
2. Section 02 41 00 – Demolition and Site Preparation
3. Section 31 00 00 – Earthwork
4. Section 31 13 00 – Tree Pruning and Removals

1.3 SPECIAL CONDITIONS

A. No burning will be permitted on the project site.

B. Prior to commencing work, the Contractor shall submit a plan for legal disposal of removed materials, acceptable to the Owner.

1.4 DEFINITIONS

A. The following related items are included herein and shall mean:

1. S.S.H.B.: The Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, latest edition
2. A.O.A.C.: Association of Official Agricultural Chemists
3. A.A.N.: American Association of Nurserymen

1.5 SUBMITTALS

A. Prior to ordering the below listed materials, submit representative samples to Landscape Architect for selection and approval, in accordance with requirements of General Condition and special provisions as follows. Do not order material until Landscape Architect's approval has been obtained. Delivered materials shall closely match the approved samples.

1. Topsoil: The Contractor shall provide a one (1) cubic foot representative sample from each proposed source for testing and approval as directed by the Landscape Architect. The Contractor shall deliver samples to testing laboratory prior to any loaming and shall have the testing report sent directly to the Landscape Architect, and pay all costs.

a. Mechanical and chemical (pH soluble salts) analysis shall be by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists.

b. Report shall be submitted at least one (1) month before any loaming is to be done. Soil tests shall be for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Soluble Salts, and Lead, and show acidity and USDA classification of the soil.

2. Submit a written guarantee of conformance to specifications for seed mixes.
3. Submit material specifications and installation instructions where applicable attesting that soil additives meet the requirements specified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All topsoil, whether from stockpiles on site or loam borrow, shall be stored in piles not to exceed six feet in height, and shall not be handled when frozen or not in a friable condition.

1.7 CERTIFICATION OF ACCEPTANCE AND GUARANTEE

A. The Contractor shall be responsible for maintenance until the LATER of: the acceptance of the project as substantially complete, or 90 days after installation. After the minimum ninety (90) day maintenance period and substantial completion of the project, the Contractor shall request of the Landscape Architect, in writing, an inspection to determine whether the lawns and plantings are acceptable. If the plant material and workmanship are acceptable, written notice will be given by the Landscape Architect to the Contractor stating that the guarantee period begins from the date of the Certificate of Acceptance. Acceptance shall be given only for the entire lawn area covered by the Contract, and for all plantings.

B. Lawns shall exhibit a uniform, thick, well-developed stand of grass, which has received a minimum of three cuttings. Lawn areas shall have no bare spots in excess of four inches in diameter, and bare spots shall comprise no more than two percent of the total area of the lawn. No lawn areas shall exhibit signs of damage from erosion, washouts, gullies, or other causes.

C. Lawns, shrubs and perennials shall be guaranteed for a period of one calendar year after inspection and acceptance and shall be alive and in satisfactory growth at the end of the guarantee period. Trees 3” caliper or greater shall be guaranteed for a period of two calendar years after inspection and acceptance.

D. At the end of the guarantee period, inspection will be made again. Any lawn area or planting covered under this contract that is dead or unsatisfactory shall be replaced according to the planting seasons called for herein, until the lawn or planting lives through one guarantee period. A final inspection for acceptance will be made after the replacement plantings have lived through

one guarantee period. Contractor shall test soil and add fertilizer and lime as needed in the fall after installation.

E. All replacements shall be the same turf mix (seed) or species and cultivar (plantings) as originally installed and accepted. The cost shall be borne by the Contractor.

1.8 SITE CONDITIONS

A. All areas to be planted shall be inspected by the Contractor before starting work and any defects such as incorrect grading, etc., shall be reported to the Landscape Architect prior to beginning this work. The commencement of work by the Contractor shall indicate their acceptance of the areas to be planted and they shall assume full responsibility.

B. Environmental Requirements: Contractor shall not work on or with soils when they are dry, wet, or frozen. Field Test: Form soil in palm of hand; if soil retains shape and crumbles upon touching, then it may be worked (if it will not retain its shape, it is too dry; if it does not crumble, it is too wet). Landscape Architect shall be final authority on condition of soil.

1.9 PROTECTION

A. The Contractor shall be liable for any damage to property caused by the work, and all areas disturbed shall be returned to their original condition to the satisfaction of the Landscape Architect. During all work of this section, the Contractor shall protect all site improvements from contact with agricultural chemicals, soil amendments, and fertilizers.

B. The Contractor shall provide all erosion, sedimentation, and environmental controls necessitated by site and governing codes.

C. Damage no plant to remain by burning, by pumping of water, by cutting of live roots or branches, or by any other means. No plant to be saved shall be used for crane stays, guys, or their fastenings. Vehicles shall not be parked within the dripline of trees to remain, or wherever damage may result to trees to be saved. Construction material shall not be stored beneath trees to be saved. See Drawings for Tree Protection.

PART 2 - PRODUCTS

2.1 TOPSOIL/LOAM

A. Loam shall be a "fine sandy loam" or a "sandy loam" determined by mechanical analysis and based on the USDA classification system. It shall be of uniform composition, without admixture of subsoil. It shall be free of stones greater than one inch, lumps, plants and their roots, debris and other extraneous matter over one inch in diameter or excess of smaller pieces of the same materials as determined by the Landscape Architect. It shall not contain toxic substances harmful to plant growth. Loam shall contain not less than 4% nor more than 10% organic matter as determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 F, plus or minus 9.

B. Loam shall have an acidity range of pH 5.6 to pH 6.5.

C. The amount of either sulfur or limestone required to adjust the planting loam to the proper pH range (above) shall be determined by the Landscape Architect on the basis of soil tests as specified herein.

D. Soil tests for this area shall be through the University of Massachusetts Amherst Cooperative Extension Soil Testing Laboratory, with recommendations for both Grasses/Lawns and Trees/Shrubs, or Approved Equal testing service (submit proposed alternative before testing).

2.2 PLANT MATERIALS

A. The Contractor shall furnish and plant all plants shown on the Drawings, as specified, and in quantities listed on the Plant List. No substitutions will be permitted. All plants shall be nursery-grown unless specifically authorized to be collected.

B. Plants shall be in accordance with the USA Standard for Nursery Stock of the American Association of Nurserymen, latest edition.

C. All plants shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. Only plant stock grown within the hardiness Zones 1 through 6, as established by the United States Department of Agriculture, will be accepted. The Contractor's suppliers must certify in writing that the stock has actually been grown under Zone 6 or hardier conditions for a minimum of 2 years. Plants not so certified will not be accepted.

D. The root system of each shall be well provided with fibrous roots. All parts shall be moist and show active green cambium when cut. They shall be sound, healthy, and vigorous, well-branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs or larvae.

E. All plants must be moved with the root systems as solid units with balls of earth firmly wrapped with untreated eight (8) 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 and root feeding system necessary for the healthy development of the plant. 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 balls shall remain intact during all operations. All plants that cannot be planted at once must be heeled in by setting in the ground and covering the balls with soil and then watering them.

F. The caliper of the trees shall be not less than the minimum size designated. Take caliper measurement six inches (6") above ground level up to and including four (4") caliper size and twelve inches (12") above ground for larger sizes. The trunk of each tree shall be a single trunk growing from a single unmutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire or other causes. No pruning wounds shall be present having a diameter exceeding two inches (2") and such wounds must show vigorous bark on all edges. Plants shall not be pruned prior to delivery.

G. Plants delivered by truck and plants requiring storage on site shall be properly wrapped and covered to prevent wind-drying and desiccation of branches, leaves or buds; plant balls should be firmly bound, unbroken, reasonably moist to indicate watering prior to delivery and during storage and tree trunks should be free from fresh scars and damage in handling. No trees with double-leaders or twin-heads shall be acceptable without the written approval of the Landscape Architect. The Contractor shall reject such plants at time of delivery by the nursery/supplier unless such plants were selected by the Landscape Architect as indicated by tags and seals. No plant material from cold storage will be accepted.

2.3 SOIL ADDITIVIES

A. Soil additive use shall be only as permitted under the Order of Conditions within resource areas.

B. Commercial fertilizer, humus or other additives shall be used to counteract soil deficiencies as recommended by the soil analysis and as directed by the Landscape Architect.

1. Commercial fertilizer shall be a product complying with the State and United States Fertilizer Laws. Deliver to the site in the original unopened containers which shall bear the manufacturer's Certificate of Compliance covering analysis which shall be furnished to the Landscape Architect. At least 50% by weight of the Nitrogen content shall be derived from organic materials. Fertilizer shall contain the percentages of weight of ingredients as follows, or as recommended by the soil analysis when that is significantly different:

Nitrogen	Phosphorus	Potash	
10%	10%	10%	For all plants

C. Ground dolomite limestone shall be an approved agricultural limestone containing not less than 85% of total calcium or magnesium carbonates. Limestone shall be ground to such fineness that 50% will pass through a 100 mesh sieve and 90% will pass through a 20 mesh sieve.

D. Humus shall be natural humus, reed peat or sedge peat. It shall be free from excessive amounts of zinc, low in wood content, free from hard lumps and in a shredded or granular form. According to the methods of testing of A.O.A.C., latest edition, the acidity range shall be approximately 5.5 pH to 7.6 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.

E. Superphosphate: Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 18% available phosphoric acid.

F. Water retention gel shall be used where appropriate. Mix with soil per manufacturer's directions.

2.4 LAWN GRASS SEED MIX

A. Seed Mix shall be “Black Beauty Ultra” by Jonathan Green Co. of Reading, PA or Approved Equal low-fertilizer-requirement mix designed to minimize need for irrigation.

B. Grass seed for lawn areas shall be fresh, clean, dry, new crop seed, which meets the standard of the Federal Seed Act. Seed shall be mixed in proportion by weight and testing the minimum percentages of purity and germination. Seed shall be nursery grown seed composed of grasses grown from the following seed mixtures.

Lawn Areas:

Approx % by Wt.	Common Name of Grass	% Germination
70	Tall Fescues	92
20	Perennial Ryegrass	92
10	Kentucky Bluegrass	85

C. Weed seed shall not exceed 0.1% by weight. Tall Fescue shall be a mix of “Tonto,” “Montana,” “Dorado,” or similar cultivar tall fescues. Bluegrass shall be “Madison,” “Deepblue,” “Prosperity,” or similar cultivar Kentucky bluegrass. Perennial Rye shall be “Frontier,” “Singular,” or similar cultivar Perennial Ryegrass.

2.5 BARK MULCH

A. Mulch shall be pine bark aged a minimum of six (6) months. The mulch shall be dark brown in color, free of chunks and pieces of wood thicker than one-quarter inch (1/4"). Mulch must be free of stringy material over three inches (3") in length and shall not contain, in the judgment of the Landscape Architect, an excess of fine particles. Mulch shall be 98% organic matter with the pH range of 3.5 to 4.5. Moisture content of packaged material shall not exceed 35%. Submit sample for the Landscape Architect's approval.

2.6 WOOD CELLULOSE FIBER MULCH

A. Mulch to cover hydroseeded areas shall be fiber processed from whole wood chips manufactured specifically for standard hydraulic mulching equipment. Fiber shall not be produced from recycled material such as sawdust, paper, or cardboard.

B. Moisture content shall not exceed 10%, plus or minus 3%, as defined by the pulp and paper industry standards. Fiber shall have a water holding capacity of not less than 900 grams water per 100 grams fiber.

C. The mulch shall be of such character that the fiber will be dispersed into a uniform slurry when mixed with water. It shall be nontoxic to plant or animal life.

D. For Lawn areas, the mulch shall contain a non-petroleum based organic tackifier and a green dye to allow for easy visual metering during application but shall not be injurious to plant growth. Tackifier shall be Hydrotack or approved equal. (Wildflower Mix and Restoration Mix areas are

not expected to include a tackifier due to seed suppliers' recommendations for the respective seed mix.)

2.7 INSECTIDE

A. No insecticide shall be used except as specifically approved in writing by the Landscape Architect, Conservation Agent, and the Owner's Representative.

2.8 WATER

A. The Contractor shall be responsible to furnish his/her own supply of water to the site at no extra cost.

B. All work injured or damaged due to the lack of water, or the use of too much water, shall be the Contractor's responsibility to correct. Water shall be free from impurities injurious to vegetation.

C. All new or transplanted trees shall be furnished with a Portable Drip Irrigation System (PDIS) water bag, "Gator Bags" or Approved Equal. PDIS water bags shall be UV-treated, reinforced polyethylene bags with a nylon toothed zipper extending from top to bottom of bag, capable of holding a minimum of 20 gallons of water, constructed so that they can be attached to the trees, which provide water from a minimum of three drip points.

2.9 WATERING BAGS

A. The Contractor shall furnish, maintain, and keep filled Portable Drip Irrigation System (PDIS) water bags (Treegator Bags or Approved Equal) for all new tree plantings, to ensure a consistent and even supply of water throughout the maintenance period.

B. PDIS water bags shall be UV-treated, reinforced polyethylene bags with a nylon toothed zipper extending from top to bottom of bag, capable of holding a minimum of 20 gallons of water, constructed so that they can be attached to the trees, which provide water from a minimum of three drip points.

PART 3 - EXECUTION

3.1 FINE GRADING AND LOAM

A. After the areas to be loamed have been brought to subgrade, and immediately prior to dumping and spreading the loam, the subgrade shall be loosened by disking or rototilling to a depth of at least three inches (3") to permit bonding of the loam to the subsoil. Remove all stones greater than two inches (2") and all debris or rubbish. Such material shall be removed from the site.

B. Loam shall be placed and spread over approved areas to a depth sufficiently greater than six inches (6") so that after natural settlement and light rolling, the completed work will conform to the lines, grading and elevations indicated. Supply additional loam, after testing and approval, as may be needed to give the specified depths and finished grades under the contract without additional cost to the Owner.

C. No subsoil or loam shall be handled in any way if it is in a wet, dry, or frozen condition.

D. Sufficient grade stakes shall be set for checking the finished grades. Grades shall be established which are accurate to one-tenth (1/10th) of a foot either way. Connect contours and spot elevations with an even slope.

E. After lime, fertilizer, and humus if required have been spread and incorporated into the bed, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter, and stones over one inch (1") in diameter shall be removed from the loam. Loam shall also be free of smaller stones in excessive quantities as determined by the Landscape Architect.

F. The whole surface shall then be rolled with a hand roller weighing not more than 100 lbs. per foot of width. During the rolling, all depressions caused by settlement or rolling shall be filled with additional loam and the surface shall be regraded and rolled until presenting a smooth and even finish to the required grade. The finish grades shall be inspected by the Landscape Architect for approval before final acceptance.

3.2 PLANTING

A. Furnishing and planting of any plant material includes the digging of the holes, provision of soil additives and loam, furnishing the plants of specified size with roots in the specified manner, the labor of planting and mulching and guying and staking where called for.

B. Season for Planting

1. Spring:

a.	Deciduous materials	March 21 through May 15
b.	Evergreen materials	April 15 through June 1

2. Fall:

a.	Deciduous materials	October 1 through December 1
b.	Evergreen materials	August 15 through October 15

C. Planting

1. Location for all plants and outlines for planting areas shall be staked on the ground by the Contractor for approval by the Landscape Architect before any plant pits or plant beds are dug.
2. At least fifteen (15) days prior to the expected planting date, the Contractor shall request that the Landscape Architect provide a representative to select and tag stock to be planted under this Section. The Contractor shall provide for the transportation and overnight accommodations, if necessary, for the Landscape Architect's representative during the period of time required to select and tag the plant material, at no extra cost to the Owner.
3. Plants shall be selected by the Landscape Architect at the place of growth for conformity to specification requirements as to quality, size, and variety. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work. Cost of replacement shall be borne by the Contractor.
4. Plant pits shall be circular pits with sloping sides, except for plants specifically indicated to be planted in beds. Holes for trees and shrubs shall be at least two feet (2') greater in diameter than the ball, and shall be at least three (3) times the diameter of the ball for trees where space allows, and shall be of a depth that maintains the plant’s prior relation to finish grade. Bottom of pit shall be flat or deepest at the perimeter. If pit is dug deeper than required to maintain plant’s relation to finish grade, then soil replaced under rootball shall be compacted to prevent subsequent settling of tree or shrub. If soil at bottom of pit is impermeable or poorly drained, pit shall be dug one extra foot, backfilled with planting soil mix, and compacted before installing plant.
5. After excavation, fill pit twice successively with water. If water does not drain out of pit at a minimum of two inches per hour, provisions for drainage must be made. Contractor shall document drainage test results for review by Landscape Architect.
6. Topsoil, organic material and fertilizer mix for planting soil mix shall be thoroughly premixed in the proportions of one (1) part of organic material with four (4) parts of

topsoil together with fertilizer at the rate determined by soil test. The organic material to be added shall be as directed by the Landscape Architect. One part of existing soil shall be mixed with two parts of planting soil mix for use in backfilling around rootball. Maintain at all times during the planting operations one or more stockpiles of approved planting soil mix.

7. Install slow release fertilizer packets per manufacturers' directions with each newly planted tree.
8. All plant roots and earth balls must be damp and thoroughly protected from sun and wind from the beginning of the digging operation, during transportation and on the ground until the final planting. The plants shall be planted in the center of the holes and at the same depth as they previously grew (see a. below). Set plants upright, plumb, and faced to give the best appearance or relationship to each other or adjacent structures. Remove burlap, rope, wires, etc., from the sides and tops of root balls. Do not pull burlap out from under root balls. Any girdling roots or badly damaged roots must be cleanly pruned off. Planting soil mix shall be backfilled in layers of not more than six inches (6") and each layer watered sufficiently to settle before the next layer is put in place. Enough planting soil mix shall be used to bring the surface to finish grade when settled. A saucer shall be formed around each plant at a depth of six inches (6") for trees.

    a. The Root Flare of each plant shall be located at the finish grade and visible. All planting depths shall be inspected by the Landscape Architect and the Owner's Representative, and if not at the proper depth shall be corrected at the Contractor's expense.

D. All plants shall be flooded with 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. At each watering the soil around each plant shall be thoroughly saturated. If sufficient moisture is retained in the soil, as determined by the Landscape Architect, the required watering may be reduced. Trees will require a minimum of ten (10) gallons of water each.

E. Mulch material shall be placed over entire saucer areas of individual trees and over the entire area of planting beds to a depth of three inches (3") after settlement, not later than one (1) week after planting. No mulch shall be applied prior to the first watering of plant materials. Mulch shall be pulled back two inches (2") from tree trunks.

F. Portable Drip Irrigation System watering bags shall be installed as directed by the bag manufacturer, and shall be kept filled as necessary to maintain optimum health.

G. Antidesiccant shall be applied to all plants before digging at the nursery and/or as directed by the Landscape Architect once the plants have been delivered to the site.

H. Antidesiccant shall be applied to all evergreen plants in the late fall as directed by the Landscape Architect.

I. If planting is done after lawn preparation or installation proper protection of lawn areas shall be provided and any damage resulting from planting operations shall be repaired immediately at no cost to the Owner.

J. In the event that rock or underground construction work or obstructions are encountered in any plant pit or bed excavation work to be done under this Contract, alternate locations may be selected by the Landscape Architect.

K. Absolutely no debris may be left on the site. Excavated material shall be removed as directed by the Landscape Architect. Repair any damage to site or structures to restore them to their original condition as directed by the Landscape Architect, at no cost to the Owner.

3.3 SOIL ADDITIVES

A. Follow all recommendations for soil additives as determined by an approved Soil Testing Laboratory, and all manufacturers' instructions pertaining to additives.

3.4 BARK MULCH

A. Contractor shall install approved bark mulch material to the limits and depths shown on the Drawings and specified herein.

3.5 GRASS SEED

A. Grass seed for lawn areas shall be fresh, clean, dry, new crop seed, which meets the standard of the Federal Seed Act. Seed shall be mixed in proportion by weight and testing the minimum percentages of purity and germination. Seed shall be nursery grown seed composed of grasses grown from the following seed mixtures.

Lawn areas:

Approx % by Wt	Common Name of Grass	% Germination
70	Tall Fescues	92
20	Perennial Rye grass	92
10	Kentucky Bluegrass	85

B. Weed seed shall not exceed 0.1% by weight. Tall Fescue shall be a mix of "Tonto," "Montana," "Dorado," or similar cultivar tall fescues. Bluegrass shall be "Madison," "Deepblue," "Prosperity," or similar cultivar Kentucky bluegrass. Perennial Rye shall be "Frontier," "Singular," or similar cultivar Perennial Ryegrass.

C. Seed Mix shall be "Black Beauty Ultra" by Jonathan Green Co. of Reading, PA or Approved Equal.

3.6 MAINTENANCE AND PROTECTION OF PLANTS AND LAWN AREAS

A. Maintenance shall begin immediately after an area is planted or seeded and shall continue until final acceptance. The minimum maintenance period shall be ninety (90) calendar days after completion of all plant installations. Watering and mowing shall be done by the Contractor for the full 90 days.

B. Maintenance shall include replacement of trees and/or shrubs, mowing, watering, weeding, re-seeding if needed, and fertilizing.

C. Watering of Lawn Areas:

1. First week: The Contractor shall provide all labor and arrange for all watering necessary for rooting of the plant materials. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantity to maintain moist soil to a depth of at least 4 inches. Watering shall not be done during the heat of the day to help prevent wilting.
2. Second and Subsequent weeks: The Contractor shall water the lawn and plantings as required to maintain adequate moisture, until final acceptance, in the upper 4 inches of soil.
3. Watering shall be done in a manner that will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply one (1) complete coverage to the lawn areas and plantings in an eight (8) hour period.

D. Watering of Tree Plantings:

1. Portable Drip Irrigation System watering bags shall be kept filled as needed to maintain optimal plant health. Bags shall be filled a minimum of once each week regardless of rain conditions. The contractor shall be responsible for ensuring that watering bags are kept full for one full growing season after installation.

E. Mowing: The first mowing of lawn areas shall not be attempted until the lawn is firmly rooted and secure in place. Not more than 40% of the grass leaf shall be removed by initial or subsequent mowings. Grass height shall be maintained between 2 inches and 2-1/2 inches unless otherwise specified. Thereafter grass shall be maintained at 2 inches until acceptance.

F. Fertilizing: A second application of fertilizer, as specified herein and as outlined in the fertilizing schedule to be submitted by the Contractor, shall be applied approximately 6 weeks after the sod has been installed as directed by the Landscape Architect. Fertilizer shall be applied at the rate of 10 pounds per 1,000 square feet or as otherwise approved as part of the fertilizing schedule.

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SECTION 333000

SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:

1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.

2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

C. All sanitary sewers and appurtenances shall be designed and constructed in accordance with TR-16, “Design and Construction of Sanitary and Storm Sewers” as prepared by the Technical Advisory Board of the New England Interstate Water Pollution Control Commission.

D. All work shall conform to the following standards

1. ASTM D 3034 Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
2. ASTM D 3212 Joints for Sewer Pipes using Flexible Elastomeric Seals Federal Specification.

1.3 SUMMARY

A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:

1. Precast concrete and Cast-in-place concrete manholes.
2. Gravity Sewer Piping.
3. Force Main Piping.
4. Prepackaged Sewer Pump

1.4 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.5 PERFORMANCE REQUIREMENTS

A. Pipe used for sanitary sewers shall be SDR 35 unless specified otherwise on the Drawings.

1.6 SUBMITTALS

A. Provide Shop Drawings for the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
2. Pipe: Include specifications on pipe materials, dimensions, and physical characteristics.

B. Conformance Certificates: Each shipment of castings, concrete manholes, pipe, pipe fittings, and appurtenances, shall be accompanied by the manufacturer's notarized certification and cylinder testing that materials meet specified requirements.

C. Permits

1. Provide Engineer with copy of all permits required prior to commencing work.

1.7 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. Deliveries shall be scheduled so that the progress of the work is at no time delayed and also so that large quantities of products shall not be stored for excessive lengths of time in crowded locations or in locations where large storage areas might be considered objectionable.

E. Avoid damage to pipe from impact, bending, compression, or abrasion during handling and storage.

F. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat, and the direct rays of the sun.

G. Use only nylon-protected slings to handle pipe. The use of hooks or bare cables will not be permitted.

H. The Contractor shall dispose of pipe damaged during delivery, handling, or storage and replace at no cost to the Owner.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: do not interrupt service to facilities occupied by Owner or others.

1.9 PERMITS

A. The Contractor shall obtain any permits required by the local authority prior to commencing with work affecting the sanitary sewer system.

B. No work shall commence until the Contractor has acquired all required permits and receives authorization from the Engineer.

1.10 MARKINGS

A. Mark pipe with the following information applied at intervals of not more than 5 feet:

1. Manufacturer's name or trademark.
   a. Nominal pipe size;
   b. PVC cell classification;
   c. Applicable dimension ratio;
   d. Date and location of manufacturer;
   e. Applicable standard designation number.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

A. Underground-Type Line Markers for Non-Metallic Pipelines: Manufacturer's standard permanent detection tape, bright-colored, continuous printed polyethylene tape with a metallic core for each detection of non-metallic underground installations, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green detection tape with black printing reading "CAUTION SEWER LINE BURIED BELOW" as manufactured by Seton or approved equivalent.

2.2 POLYVINYL CHLORIDE GRAVITY SEWER PIPE

1. PVC pipe. Pipe and fittings for main sewer pipe may be polyvinyl chloride (PVC) made by a manufacturer of established reputation, meeting the requirements of ASTM-D-3033 or D-3034-77 or the latest revision thereto, with a pipe diameter to wall thickness ratio (SDR) of thirty-five (35). Maximum pipe length shall be thirteen (13) feet with elastomeric ring, bell and spigot style joint, meeting the requirements of ASTM-D3212-76 or the latest revision thereto.

2. Laterals. Pipe and fittings for laterals shall be polyvinyl chloride (PVC), six (6) inches in size and meeting the same requirements as for the main pipe. Fittings shall be molded one-piece construction, and a PVC cap, designed for use on the bell end of the pipe, shall be used where necessary.

3. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusion, or other injurious defects. The pipe shall be as uniform as commercially practical in color, capacity, density, and other physical properties.
4. Joints shall be bell and spigot. The bell shall consist of an integral wall section with a solid cross section rubber ring factory-assembled, securely locked in place to prevent displacement. Joints shall conform to ASTM Standard D 3212. For SCH 40 PVC piping, joints shall be glued with a PVC cement approved by the manufacturer.
5. All fittings and accessories shall have dimensions as recommended by the manufacturer and have bell and/or spigot configurations compatible with that of the pipe.
6. Pipe shall pass impact resistance test in accordance with ASTM D 2444 and minimum pipe stiffness test at 5% deflection in accordance with ASTM D 2412.
7. The normal length of 12-inch size and smaller pipe shall be 12.5 feet and 15-inch size shall be no longer than 20 feet.
8. Pipe and fittings shall be manufactured in the United States of America and shall be accompanied by the manufacturer's certificate of compliance, in addition to meeting the performance tests specified hereinafter.
9. If required by the Owner’s representative, prior to installation, six specimen lengths each 6-inches long of each size pipe shall be furnished by the Contractor for impact resistance test and three specimen lengths each 6-inches long of each size pipe for pipe stiffness test. These tests are to be made in accordance with ASTM D 2444 and ASTM D 2412,

respectively, at the expense of the Contractor. No pipe shall be accepted if the tests do not meet the test requirements.

10. Sanitary building sewer connections. Wyes shall be required for all sanitary building sewer connections to the public sewer main and shall be the same type of material and manufacture as the pipe. Connections to an existing public sewer main shall be accomplished by the use of a cast-iron saddle with stainless steel strap and bolts.

B. PVC pipe shall be SCH 40 where pipe has less than 2 feet of cover or as directed by the Engineer.

1. PVC pipe shall meet ASTM F794, latest revision.
2. Joints shall be bell and spigot. Joints shall be glued with a PVC cement approved by the manufacturer.

2.3 NONPRESSURE-TYPE PIPE COUPLINGS

A. Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end as manufactured by Fernco, Inc. or approved equivalent.

2.4 POLYVINYL CHLORIDE FORCE MAIN SEWER PIPE

1. PVC pipe. Pipe and fittings for main sewer pipe may be polyvinyl chloride (PVC) made by a manufacturer of established reputation, meeting the requirements of ASTM-D-3033 or D-3034-77 or the latest revision thereto, with a pipe diameter to wall thickness ratio (SDR) of twenty-six (26). Maximum pipe length shall be thirteen (13) feet with elastomeric ring, bell and spigot style joint, meeting the requirements of ASTM-D3212-76 or the latest revision thereto.

2. Laterals. Pipe and fittings for laterals shall be polyvinyl chloride (PVC), six (6) inches in size and meeting the same requirements as for the main pipe. Fittings shall be molded one-piece construction, and a PVC cap, designed for use on the bell end of the pipe, shall be used where necessary.

3. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusion, or other injurious defects. The pipe shall be as uniform as commercially practical in color, capacity, density, and other physical properties.
4. Joints shall be bell and spigot. The bell shall consist of an integral wall section with a solid cross section rubber ring factory-assembled, securely locked in place to prevent displacement. Joints shall conform to ASTM Standard D 3212. For SCH 40 PVC piping, joints shall be glued with a PVC cement approved by the manufacturer.
5. All fittings and accessories shall have dimensions as recommended by the manufacturer and have bell and/or spigot configurations compatible with that of the pipe.
6. Pipe shall pass impact resistance test in accordance with ASTM D 2444 and minimum pipe stiffness test at 5% deflection in accordance with ASTM D 2412.
7. The normal length of 12-inch size and smaller pipe shall be 12.5 feet and 15-inch size shall be no longer than 20 feet.
8. Pipe and fittings shall be manufactured in the United States of America and shall be accompanied by the manufacturer's certificate of compliance, in addition to meeting the performance tests specified hereinafter.
9. If required by the Owner’s representative, prior to installation, six specimen lengths each 6-inches long of each size pipe shall be furnished by the Contractor for impact resistance test and three specimen lengths each 6-inches long of each size pipe for pipe stiffness test. These tests are to be made in accordance with ASTM D 2444 and ASTM D 2412, respectively, at the expense of the Contractor. No pipe shall be accepted if the tests do not meet the test requirements.

10. Sanitary building sewer connections. Wyes shall be required for all sanitary building sewer connections to the public sewer main and shall be the same type of material and manufacture as the pipe. Connections to an existing public sewer main shall be accomplished by the use of a cast-iron saddle with stainless steel strap and bolts.

B. PVC pipe shall be SCH 40 where pipe has less than 2 feet of cover or as directed by the Engineer.

1. PVC pipe shall meet ASTM F794, latest revision.
2. Joints shall be bell and spigot. Joints shall be glued with a PVC cement approved by the manufacturer.

2.5 PRESSURE-TYPE PIPE COUPLINGS

A. Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end as manufactured by Fernco, Inc. or approved equivalent.

2.6 MANHOLE MATERIALS

A. Cement shall be Portland cement conforming to ASTM C150, Type III, high early strength.

B. Aggregate: shall conform to ASTM C330 and shall be graded, crushed stone with a resulting unit weight of concrete of up to one hundred fifty five (155) pounds per cubic foot, and a minimum unit weight of not less than one hundred forty-eight (148) pounds.

C. Water: shall be clear and free of injurious and deleterious substances.

D. Concrete: shall have a minimum strength of 5000 psi at twenty eight (28) days and a strength of 3000 psi at the time of form release.

E. During the process of manufacturing of the units not less than two (2) test cylinders shall be tested at time release of the form and two (2) at age twenty-eight (28) days.

F. All compression test cylinders shall be made, cured and stored in accordance with ASTM C31.

G. Cylinders shall be tested in accordance with ASTM C39.

H. All concrete shall be air entrained as specified per RIDOT Standard Specifications.

I. Admixtures shall only be used after prior approval of the Engineer.

J. All reinforcing bars shall conform to the requirements of ASTM designation: A615, Grade 60.

K. Welded wire fabric shall conform to the requirements of ASTM designation: A185.

2.7 PRECAST CONCRETE MANHOLES AND BRICK

A. Construction. Manholes shall be constructed of reinforced precast concrete monolithic base sections, barrel sections and dome sections and shall meet the applicable requirements of ASTM Specification C478-7OT, latest revision, design based upon H-20 loadings. All manholes delivered to the site must be approved by the Superintendent. In general, reasons for rejection will include, but not be limited to, porous or cracked walls, misformed joints and pipe connectors which vary more than one (1) inch from those indicated on the plans. Rejected manholes shall be removed from the site by the licensed pipelayer.

B. Preliminary inspection. All precast manhole sections shall be delivered to the construction site without exterior coatings. Upon on-site approval by the Superintendent, the licensed pipelayer shall apply, by roller or brush, a heavy application of emulsified asphalt waterproofing compound.

C. Unless otherwise noted on the Drawings, sanitary manholes less than or equal to ten (10) feet deep shall have an interior diameter of 48 inches. Manholes greater than ten (10) feet shall have an interior diameter of 60 inches unless otherwise noted. All manholes with interior drops shall have an interior diameter of 60 inches unless otherwise noted. Manholes with an interior diameter of 72 inches shall be utilized where indicated on the Drawings.

D. Openings for pipe insertions shall be round and shall be precast or cored only. The diameter of the opening shall be adequate to install a rubber boot seal. The cored or precast opening shall maintain a minimum undisturbed distance of 6” from manhole section joints. Flexible rubber boot shall be neoprene with stainless steel clamps and bands.

E. All concrete manholes shall have a 6 inch concrete collar integrally cast as part of the base section. Concrete collars shall be the same depth as the base of the structure

2.8 MANHOLE FRAMES AND COVERS

A. Manhole Frames and Covers shall be cast iron and conform to the details on the drawings. Cast iron shall conform to ASTM A-48, Class 25. The underside of the cover and upper side of lip frame must present parallel plane surfaces, and at these points of contact, the frames and covers shall be machined to prevent covers from rocking in the frames under traffic.

B. Frame and covers shall be capable of withstanding H-20 highway loading.

C. Covers shall bear evenly in the frame and both frame seats and covers shall be accurately fabricated so that covers are interchangeable for use with any and all frames. Where indicated, frames and covers shall be watertight, and locked. The sizes and weights (medium duty, heavy duty, etc.) are shown on the detail sheets for special manholes.

D. Mortar shall consist of one part cement and two parts clean sand. No lime shall be used.

E. Covers shall have a non-slip surface and shall have the word “SEWER” inscribed.

F. Frames and covers shall be installed on the manholes as indicated on the drawings. They shall be well bedded and encased in cement mortar and accurately set to the grades indicated or as directed. Red clay brick with cement mortar shall be used to adjust grade of frame and cover. One half inch of cement mortar plaster cast shall be applied to exterior of red clay bricks.

2.9 MANHOLE STEPS

A. Manhole steps shall be aluminum alloy 6061 T6, extruded, safety-type, cast in place, twelve (12) inches on center, in the barrel and dome sections, and the portion of the step imbedded in concrete, plus two (2) inches, shall be coated with aluminum oxide.

B. Steps may be constructed of continuous grade 60 steel bar, three-eighths (3/8) inch outside diameter, molded within polypropylene plastic with a safety tread surface. All interior steps shall be installed during manhole manufacture.

2.10 WATERPROOFING FOR UNDERGROUND STRUCTURES

A. Elastomeric waterproofing membrane shall conform to ASTM C836.

B. All exterior surfaces of underground manholes shall receive one coat of waterproofing.

2.11 SANITARY SEWER PUMPS

A. Sewer pump shall be Environment One DH-272 or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 0000 - Earthwork.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Gravity-Flow, Non-pressure Sewer Piping: Use the following pipe materials as specified on the Drawings:

1. SDR 35 sewer pipe and fittings; gaskets; and gasketed joints.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

D. The area below the pipe and extending to six (6) inches above the crown of PVC pipe and D.I. pipe shall be backfilled with compacted granular material, as specified under pipe laying, and thoroughly tamped by light tampers as placed. The remainder of the side fill to a minimum depth of twenty-four (24) inches above the top of pipe shall be a select, fine ordinary borrow material, approved for such use by the Superintendent, placed in twelve-inch layers and compacted by hand tamping. No stones larger than three (3) inches across the largest dimension will be allowed within this stratum of backfill.

E. The remainder of backfill to the surface of the ground or to the bottom of the gravel subbase in roadway locations shall be ordinary borrow, approved by the Superintendent, placed in twelve-inch layers and thoroughly compacted by mechanical rammers or vibrators. No rock larger than twelve (12) inches in diameter will be allowed within this stratum of backfill, and all voids within rock backfill must be completely filled. Alternate methods for compaction within this stratum presented by the licensed pipelayer will be considered by the Superintendent, and the licensed pipelayer shall be required to demonstrate to the Superintendent's satisfaction that his proposed method of compaction will produce the intended results for the various conditions and materials encountered.

F. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, to the slope indicated on the Drawings. An even alignment of the pipe shall be maintained.
2. Install piping with 36-inch minimum cover unless specified otherwise on the Drawings.
3. The Contractor shall excavate around the bell portion of the pipe so the pipe barrel bears on the prepared bed.

4. Blocking is not permitted.
5. All pipes shall be clean and free of dirt before laying and open ends shall be kept covered and free of dirt during construction.
6. Where new pipes are to adjoin existing structures, extreme care shall be taken in coring into existing structure. Tight waterproof connections shall be made without interrupting service.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

H. Pipe elevation. All sanitary building sewer pipe shall be laid to a minimum slope of one-fourth (1/4) inch per foot unless otherwise approved by the Superintendent. The sanitary building sewer should be brought to the building on a uniform slope and at an elevation appropriate to the connection with the existing sanitary building drain. In any building in which the building drain is too low to permit gravity flow to the public sewer, sanitary sewage carried by such building drain may be lifted by an approved means and discharged to the sanitary building sewer.

I. The Contractor shall install piping as specified to within 5 feet of the building foundation. The Plumbing Contractor shall make the connection to the sanitary sewer from this point.

J. Where installing pipe below standing water table, trench shall be dry and free of water and pipe bedding. Below bottom of pipe can be replaced with 1 ½" crushed stone.

K. Glue all joints for Sch 40 PVC pipe.

L. Provide thrust restraint for all changes in direction for the force main piping.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure, drainage piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints and manufacturer's recommendations.

1. Machinery shall not be used to push the pipe into place. The pipe shall be pushed into place by hand. The use of a hammer or mallet is permitted, with the use of a board to shield the end of the pipe being struck by the hammer. The pipe shall not be directly contacted with a hammer or mallet.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Form continuous concrete or brick channels and benches between inlets and outlet as specified on Drawings.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Red clay brick for table, invert and grade adjusting courses shall be hard burned of uniform Grade B. Red clay brick shall be laid with all joints completely filled with mortar and the inside and outside faces covered with mortar and troweled smooth. The maximum height allowable for grade adjustment of the manhole frame with the brick masonry shall be twelve (12) inches.

F. Set manhole barrel and cone sections vertically and in true alignment.

G. Concrete Base Slabs for manholes and shall have a full thickness of 12 inches extending 6 inches beyond the outside walls. Manhole joints. The joint between the base section and the barrel section shall be brushed clean and a strip of butyl rubber shall be placed completely around the joint prior to placement of the barrel section. Once the barrel section has been placed, a timber shall be placed across the top of the section and a controlled downward pressure shall be applied with the hydraulic excavating machine to the complete joint. The same method shall be used in making the joints between the remaining barrel section and dome section. Precast concrete flat slab top sections shall be used if height limitations prohibit the use of a dome section.

H. Manhole installation. The licensed pipelayer shall excavate to a depth of six (6) inches below the bottom of the manhole base, compact and fine grade and install washed screened gravel subbase material. The base section shall be placed to grade and the pipes connected. Pipes shall extend approximately one (1) inch inside the interior wall, with clamps on the connector tightened and mortar troweled on the inside face of the manhole-to-pipe connection.

I. Bottom riser sections of reinforced concrete manholes and catch basins may be either cast-in-place or precast concrete. The top edges, of cast-in-place bottom sections, shall be formed with a removable steel ring template designed to fit the tongue end of the precast riser sections.

J. Inverts and table shall be constructed of red clay brick with mortar joints. Care shall be taken in construction of brick inverts that the width of the invert shall be slightly larger than the inside diameter of the larger of the pipes entering the manhole wall. Bricks shall be laid in a full bed of mortar with push joints, and all brick shall be thoroughly wet immediately before laying.

K. Manhole table. The table shall be constructed at an elevation even with the top of the pipe and shall slope up toward side walls. Inverts shall be constructed in a manner to provide smooth flow through manholes, with no sharp turns or projecting portions of brick. Bottom sections of straight line manhole inverts may be constructed using one-half (1/2) section of pipe cut longitudinally and carefully set to grade, upon approval of the Superintendent. The half-pipe section must be securely braced during installation of concrete fill around the invert to prevent flotation. Brick for inverts shall be placed on edge and laid flat for table.

L. Joints: Pipe joints into manholes shall be constructed in accordance with the details shown on the plans. Complete details of the boot manufacture and installation shall be submitted for approval. Pipe-to-manhole connection shall be made with a flexible rubber boot and stainless steel clamp. The flexible rubber boot pipe-to-manhole connector shall be installed during manufacture of precast manhole sections and shall include a stainless steel screw clamp designed specifically for use on the size and type of pipe utilized on the project. If PVC pipe is used, a continuous bead of silicone shall be applied to the inside of the boot at the clamp location prior to installation of the pipe.

M. Sealing of joints. Once the manhole has been assembled and prior to backfill, hydraulic cement shall be applied to all lift holes and manhole joints, including exterior boot-to-manhole joint.

N. Bricks shall be laid in a workmanlike manner, true to line, and the joints shall be carefully struck and pointed on the inside. Bricks shall be thoroughly wet when laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The outside of the brickwork shall be neatly plastered with ½" layer of cement mortar as the work progresses. The brickwork shall be satisfactorily bonded to the concrete and cast iron frame. No brick masonry shall be laid in water, or any water allowed to rise on the brickwork until the masonry has set for at least 24 hours.

O. Waterproofing: All exterior surfaces of underground manholes shall receive one coat of waterproofing.

P. Backfilling. Once the vacuum test has been completed, select ordinary borrow shall be backfilled around the manhole, with no stone larger than three (3) inches within eighteen (18) inches of the concrete wall. Material shall be placed leveled and compacted in twelve-inch lifts.

3.5 IDENTIFICATION

A. Materials and their installation are specified in Section 31 00 00 - Earthwork. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.6 FIELD QUALITY CONTROL

A. 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. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: A mandrel shall be pulled through the pipe to check overall deflection, and the pipe through which a mandrel cannot be pulled without extreme force shall be considered failed. The mandrel shall have an outside diameter seven percent (7%) less than the pipe inside diameter and shall be supplied by the pipe manufacturer for this purpose..
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
2. The Contractor shall repair any defects or corrections required by the Engineer.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified at no expense to the Owner.
4. Reinspect and repeat procedure until results are satisfactory at no expense to the Owner.

B. Testing Manholes:

1. All sanitary manholes shall be vacuum tested prior to backfilling.
2. Install vacuum tester and inflate compression band to affect a seal between the vacuum base and the new manhole, connect vacuum pump to the outlet part with the valve open, draw a vacuum of 10 inches of mercury, (HG), and close the valve.
3. The manhole shall pass the test if the vacuum remains at 10 inches of HG in a time greater than 60 seconds for a manhole up to 10 feet deep, time greater than 75 seconds for a manhole 10.1 to 15 feet deep, and time greater than 90 seconds for a manhole 15-25 feet deep.
4. If the manhole fails the initial test, the Contractor shall make proper repairs or replace the manhole and re-test at no additional compensation.

C. Testing Gravity Sewers:

1. Low Pressure Air Test:
   a. After completing backfill of the pipeline, the Contractor shall, at his expense, conduct a line acceptance test. The test shall be performed according to stated procedures

and in the presence of the Engineer. The line shall be flushed and cleaned prior to testing.

b. Test guidelines. All testing shall be done by an individual or company experienced and equipped in this type of work. A certification of the test results shall be required for each section between manholes, with the stationing corresponding to the submitted plans. The Superintendent shall be notified forty-eight (48) hours in advance of testing. At no time shall construction proceed further than two thousand (2,000) feet from the last section tested.

c. All pneumatic plugs shall be seal-tested before being used in the actual test installation. One (1) length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

d. After a manhole-to-manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average backpressure of any groundwater that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.

e. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "acceptable". If the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) shall not be less than one and zero-tenths (1.0) minute per inch diameter of the particular pipe being tested.

f. If the installation fails the air test, the Contractor shall, at his expense determine the source of leakage. He shall then repair or replace all defective materials and/or workmanship to Engineer's satisfaction and the pipeline shall be re-tested, all performed at no additional compensation to the Contractor.

2. Infiltration Test:

a. The infiltration test shall be conducted at such time as the ground water level is at a height of not less than one foot above the top of the pipe for the full length of the section of sewer being tested.

b. Each manhole-to-manhole reach shall be tested separately. At no time will the Contractor be allowed to test more than one manhole-to-manhole reach.

c. The Contractor shall construct such weirs or other means of measurement as shall be required and shall do such pumping as shall be necessary to enable the tests to be made satisfactorily.

d. The groundwater leakage into the pipes will be measured by the Engineer after a minimum of one hour and the infiltration rate shall not exceed 50 gallons per day per mile per inch-diameter.

D. Pipe Deflection:

1. Pipe provided shall be so installed that there be a maximum deflection of 7 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter of the pipe less minimum diameter when measured) by 100 and dividing by the nominal pipe diameter.

2. The Contractor shall measure the amount of deflection by pulling a specially designed gauge assembly through the completed section after 120 days of installation. The gauge assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.

3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.

E. Leaks and loss in test pressure constitute defects that must be repaired. All repairs shall be at the expense of the Contractor.

F. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 CLEANING

A. Interior of piping and manholes shall be cleaned of dirt and superfluous material prior to acceptance of sanitary sewer.

3.8 CLOSING ABANDONED SANITARY SEWERAGE 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. Use either procedure below:

1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 60 inches below final grade

3.9 RECORD DRAWINGS

A. All installed underground utilities shall be designated on as-built drawings by the contractor of record and provided to the Owner and Engineer in AutoCad electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.

END OF SECTION

SECTION 334000

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. All work specified in this Section shall conform to “Standard Specifications for Highway and Bridges” of the Massachusetts Department of Transportation, latest revision, herein referred to as “State Standards”.

B. Existing Conditions Plan compiled from the following sources:

1. Existing conditions mapping taken from plan entitled “Existing Conditions Plan 152 Park Street North Reading, MA” prepared by Brennan Consulting of Burlington, MA dated March 17, 2023.

2. Wetland Flags identifying wetland resource areas were placed by Pare Corporation on March 29, 2023 and located by Pare with a GPS device.

1.3 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:

1. Pipe
2. Precast concrete drain manholes
3. Precast concrete catch basins
4. Grates
5. Subdrainage
6. Trench drains
7. PVC Barrier
8. Cleanouts
9. Area Drains
10. Underground Detention System

1.4 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. HDPE High Density Polyethylene.

C. RCP Reinforced Concrete Pipe

D. PE: Polyethylene

1.5 SUBMITTALS

A. The Contractor shall submit for approval, manufacturer's printed recommendations for the storage, protection, handling, installation and testing of stormwater piping, fittings and appurtenances, which shall be strictly adhered to by the Contractor.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
2. Catch Basins: Include plans, elevations, sections, details, and frames, covers, and grates.
3. Trench Drain: Include plans, elevations, section details and grates.
4. Pipe of all materials.
5. PVC Barrier: Include specifications on materials, dimensions, and physical characteristics. Indicate manufacturer's recommended method for joining and bonding multiple sections.

C. Conformance Certificate: Each shipment of castings and concrete manholes and catch basins shall be accompanied with the manufacturer's notarized certification and cylinder testing results that materials meet specified requirements.

D. Record Drawings: All installed underground utilities shall be designated on as-built drawings by the contractor of record and provided to the Owner and Engineer in AutoCad electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe, pipe fittings, and seals from dirt and damage.

B. Handle catch basins and manholes according to manufacturer's written rigging instructions.

C. Use only nylon-protected slings to handle pipe. The use of hooks or bare cables will not be permitted.

D. Avoid damage to castings from impact, abrasion, or corrosion during handling and storage.

E. Do not store PVC piping and fittings in the sunlight for extended periods of time. Store pipe in accordance with manufacturer's recommendations.

F. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun.

G. Use all means necessary to protect precast concrete units and materials before, during and after installation and to protect the installed work and materials for all other trades.

H. In case of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative at the Contractor's expense.

I. Pipe, pipe fittings, and other associated appurtenances damaged during deliver handling or storage shall be replaced at no additional cost to the Owner.

1.7 PROJECT CONDITIONS

A. The Contractor shall provide means of stormwater management during construction to control runoff and protect downstream areas from damage resulting from stormwater runoff.

B. The Contractor is responsible for any damage resulting from stormwater runoff during construction, including damage from flooding.

1.8 QUALITY CONTROL

A. All precast concrete shall be the product of a manufacturer who has demonstrated capability to produce precast concrete products of the quality specified. A manufacturer must be able to show that he has experienced personnel, physical facilities, established quality control procedures, and a management capability sufficient to execute the work of this contract. When requested by the Owner's Representative, the Contractor shall submit written evidence of the above requirements.

B. Experienced plant personnel shall closely supervise the manufacturing process, and daily records of concrete strength shall be kept and submitted to the Owner's Representative for control.

C. Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly trained and experienced in the installation of the precast concrete structures and shall direct all work performed under this Section.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Profile Gravity Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends.

B. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusion or other injurious defects. The pipe shall be as uniform as commercially practical in color, capacity, density and other physical properties.

C. Joints shall be bell and spigot. For SDR-35 PVC pipe, the bell shall consist of an integral wall section with a solid cross section rubber ring factory-assembled, securely locked in place to prevent displacement. Joints shall conform to ASTM Standard D 3212. For SCH 40 PVC piping, joints shall be glued with PVC cement approved by the manufacturer.

D. All fittings and accessories shall have dimensions as recommended by the manufacturer and have bell and/or spigot configurations compatible with that of the pipe.

E. Pipe shall pass impact resistance test in accordance with ASTM D 2444 and minimum pipe stiffness test at 5% deflection in accordance with ASTM D 2412.

F. The normal length of 12-inch size and smaller pipe shall be 12.5 feet.

G. Pipe and fittings shall be manufactured in the United States of America and shall be accompanied by the manufacturer's certificate of compliance, in addition to meeting the performance tests specified hereinafter.

H. PVC pipe shall be SCH 40 where pipe has less than 2 feet of cover or as directed by the Owner's Representative.

I. PVC perforated pipe shall conform to ASTM/ANSI D 2759 or ASTMF 810. Perforations shall be 5/8” holes on 5” centers.

2.2 HIGH-DENSITY POLYETHYLENE PIPE AND FITTINGS

A. High-Density Polyethylene Pipe and fittings shall be ADS N-12 IB ST Smooth Interior Pipe, ADS N-12 IB ST High Capacity Large Diameter Pipe or approved equivalent. Joints shall be soil-tight and include a rubber gasket on the spigot end of the pipe. When installed into the bell end, the joint shall be sealed.

B. Pipe shall conform to AASHTO M294 (Type ‘S’) for the specified diameters and strength classes.

C. Pipe shall be rated to withstand H-20 Loading Criteria with 18” of cover.

2.3 REINFORCED CONCRETE PIPE

A. Reinforced-Concrete Pipe and Fittings: ASTM C 76 (ASTM C 76M), with bell-and-spigot ends and sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant.

B. Pipe shall conform to AASHTO M170 for the specified diameters and strength classes. The minimum cement content shall be 564 pounds per cubic yard.

C. Strength class of reinforced concrete pipe shall be Class III unless specified otherwise on the drawings.

D. Joint of reinforced concrete pipe shall be made with flexible watertight rubber gaskets and the remaining exterior void of the joint shall be sealed with Portland cement mortar.

2.4 FLEXIBLE PIPE COUPLINGS

A. Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end as manufactured by Fernco Inc. or approved equivalent.

2.5 CLEANOUTS

A. Cast-Iron Cleanouts: Frame and cover shall be able to withstand HS-20 loading criteria.

B. PVC cleanouts: PVC body with PVC cap and screw type cover set no more than 6” below cast iron frame and cover. The cast iron cover shall be set to finish grade and secured with concrete as shown in the Drawings. Frame and cover shall be able to withstand H20-44 loading criteria.

2.6 MANHOLE AND CATCH BASIN MATERIALS

A. Cement shall be Portland cement conforming to ASTM C150, Type III, high early strength.

B. Aggregate: shall conform to ASTM C330 and shall be graded, crushed stone with a resulting unit weight of concrete of up to one hundred fifty-five (155) pounds per cubic foot, and a minimum unit weight of not less than one hundred forty-eight (148) pounds.

C. Water: shall be clear and free of injurious and deleterious substances.

D. Concrete: shall have a minimum strength of 5000 psi at twenty-eight (28) days and a strength of 3000 psi at the time of form release.

E. During the process of manufacturing of the units not less than two (2) test cylinders shall be tested at time release of the form and two (2) at age twenty-eight (28) days.

F. All compression test cylinders shall be made, cured and stored in accordance with ASTM C31. Cylinders shall be tested in accordance with ASTM C39.

G. All concrete shall be air entrained as specified per MADOT Standard Specifications.

H. Admixtures shall only be used after prior approval of the Engineer.

I. All reinforcing bars shall conform to the requirements of ASTM designation: A615, Grade 60.

J. Welded wire fabric shall conform to the requirements of ASTM designation: A185.

2.7 PRECAST CONCRETE MANHOLES, CATCH BASINS AND BRICK

A. Precast Concrete Manhole and Catch Basin sections shall be equal to that shown on the drawings and shall conform to ASTM Specifications C-478 and C-76 Class IV Wall “B”. The horizontal joints between sections shall be sealed using a flexible butyl resin sealant and shall conform to ASTM C-990. In addition, the horizontal joints on the inside and outside of the manhole and catch basin shall be sealed with a “Quick Plug” as manufactured by Parson or approved equal.

B. Brick shall conform to ASTM Specification C-32, except that the table therein is amended to provide that the required minimum compressive strength in pounds per square inch shall be for any individual brick 3,000 or 5,000 for the average of five bricks selected at random. The maximum absorption of water by five-hour boiling test shall not exceed 16% for any individual brick or 12% for the average of any five bricks selected at random.

C. Unless otherwise noted on the Drawings, manholes less than fifteen (15) feet deep shall have an interior diameter of 48 inches. Manholes fifteen (15) feet and deeper shall have an interior diameter of 60 inches unless otherwise noted. Manholes with an interior diameter of 72 inches shall be utilized where indicated on the Drawings. All catch basins shall have an interior diameter of 48 inches unless specified otherwise.

D. Openings for pipe insertions shall be round and shall be precast or cored only. The diameter of the opening shall be adequate to install a rubber boot seal. The cored or precast opening shall maintain a minimum undisturbed distance of 6” from manhole section joints. Flexible rubber boot shall be neoprene with stainless steel clamps and bands.

E. Weirs for diversion manholes may be constructed with concrete block joined with mortar or cast into the structure. Contractor shall form each weir as depicted on the plans. Provide a watertight seal with no gaps between weir wall and structure wall. Weirs shall be connected to structure wall using epoxy coated steel rebar reinforcement.

2.8 MANHOLE FRAMES AND COVERS

A. Manhole Frames and Covers shall be cast iron and conform to the details on the drawings. Cast iron shall conform to ASTM A-48, Class 25. The underside of the cover and upper side of lip frame must present parallel plane surfaces, and at these points of contact, the frames and covers shall be machined to prevent covers from rocking in the frames under traffic.

B. Covers shall bear evenly in the frame and both frame seats and covers shall be accurately fabricated so that covers are interchangeable for use with any and all frames. Where indicated, frames and covers shall be watertight, and locked. The sizes and weights (medium duty, heavy duty, etc.) are shown on the detail sheets for special manholes.

C. Mortar shall consist of one part cement and two parts clean sand. No lime shall be used.

D. Covers shall have a non-slip surface and shall have the word “DRAIN”, inscribed.

E. Frames and covers shall be installed on the manholes as indicated on the drawings. They shall be well bedded and encased in cement mortar and accurately set to the grades indicated or as directed. Red clay brick with cement mortar shall be used to adjust grade of frame and cover. One half inch of cement mortar plaster cast shall be applied to exterior of red clay bricks.

F. All concrete manholes shall have a 6 inch concrete collar integrally cast as part of the base section. Concrete collars shall be the same depth as the base of the structure.

2.9 CATCH BASIN FRAMES AND GRATES

A. Catch Basin Frames and Grates shall be cast iron and conform to the details on the drawings. Cast iron shall conform to ASTM A-48, Class 25. The underside of the grate and upper side of lip frame must present parallel plane surfaces, and at these points of contact, the frames and grates shall be machined to prevent grates from rocking in the frames under traffic.

B. Grate shall bear evenly in the frame and both frame seats and grates shall be accurately fabricated so that grate is interchangeable for use with any and all catch basin frames.

C. Beehive grates shall be installed on the catch basins as indicated on the drawings.

D. Gratings shall have a non-slip surface.

E. Gratings shall be installed on the catch basins as indicated on the drawings. They shall be well bedded and encased in cement mortar and accurately set to the grades indicated or as directed. Red clay brick with cement mortar shall be used to adjust frame and grate. One half inch of cement mortar plaster cast shall be applied to exterior of red clay bricks.

2.10 MANHOLE STEPS

A. Manhole steps shall be manufactured of Copolymer Polypropylene plastic with ½” grade 50 steel reinforcement.

B. Steps shall conform to ASTM D-4101 under Type II.

C. The capacity of each step shall be 1000 lb. at 5-1/8 inch distance from wall and 1500 lb. at 4-inch distance from wall.

D. Steps shall measure 12 inches wide (min.) and extend 5-1/8 inches from wall.

E. Manhole steps shall be provided in each base, riser and top section and shall be integrally cast in each; 12 inches O.C.

2.11 GEOTEXTILES

A. Refer to Section 310000 for requirements regarding geotextile filter fabrics.

2.12 IDENTIFICATION

A. Underground-type line markers for non-metallic pipelines: manufacturer's standard permanent detection tape, bright-colored, continuous printed polyethylene tape with a metallic core for each detection of non-metallic underground installations, intended for direct-burial service; not less

than 6" wide x 4 mils thick. Provide green detection tape with black printing reading "Caution Drain Line Buried Below" as manufactured by Seton or approved equivalent.

2.13 CATCH BASIN HOODS

A. All catch basin outlet pipes on new catch basins and all outlet pipes on existing catch basins shall be fitted with a catch basin hood.

2.14 OUTLET CONTROL STRUCTURES

A. Provide precast control structures, outlet structures shall conform to the dimensions shown on the plans and details and shall include a including galvanized steel bar grate fastened to the top of the unit. Outlet control structures shall be precast concrete units designed for AASHTO HS20-44 loading, with openings as shown on the detail drawings.

2.15 STORMWATER HYDRODYNAMIC SEPERATOR

A. Acceptable suppliers may be Vortsentry Contech Stormwater Solutions, Hydroguard by Hydroworks, Downstream Defender, or approved equivalent.

B. Materials and Design

1. Concrete for precast stormwater treatment systems shall conform to ASTM C857 and C478 and meet the following additional requirements:
   a. In all cases the wall thickness shall be no less than the minimum thickness necessary to sustain HS20 loading requirements.
   b. Sections shall have tongue and groove or ship-lap joints with a butyl mastic sealant conforming to ASTMT C990.
   c. Cement shall be Type I, II, or III Portland cement conforming to ASTM C150.
   d. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has attained a compressive strength of 4,000 psi (28 MPa) or other designate suitable handling strength.
   e. Pipe openings shall be sized to accept pipes of the specified size(s) and material(s), and shall be sealed by the Contractor with a hydraulic cement conforming to ASTM C595M.

C. Performance

1. Each stormwater treatment system shall have treatment, sediment storage, and oil storage capacities equal to or greater than that shown on the table on the project plans. For the purpose of determining equivalency, the treatment capacity shall be defined as the flow rate at which the stormwater treatment system removes 80% of an unground silica sample having an average particle size equal to or less than 240 microns. Treatment capacity shall be additionally defined as the maximum flow rate prior to which bypass of any flow occurs. Calculations must be provided to show the criteria are met with the shop drawing for the treatment system submitted.
2. Each stormwater treatment system shall provide documented full-scale testing that corroborates the capacities as listed in the table above and defined above. Said documentation shall include at a minimum testing for removal capabilities and sediment wash-out characteristics at the treatment capacities listed in table above.
3. Each stormwater treatment system shall have the capability of bypassing high flow internally as well as controlling through the treatment chamber so as to avoid wash-out of previously captured pollutants under high flow conditions.
4. Each stormwater treatment system shall include a circular chamber with a tangential inlet to induce a swirling flow pattern within the treatment chamber. The outlet from the

treatment chamber shall be located in the center of the chamber so as to maximize the particle flow path within the treatment system.

5. Each stormwater treatment system shall be of a hydraulic design that includes flow controls designed and certified by a professional engineer using accepted principles of fluid mechanics that raise the water surface inside the tank to a pre-determined level in order to prevent the re-entrainment of trapped floating contaminants.
6. Each stormwater treatment system shall be designed to not allow surcharge of the upstream network during dry weather conditions.
7. Each stormwater treatment system shall be contained within one concrete manhole structure.

2.16 AREA DRAINS

A. PVC surface drainage inlets shall include the drain basin type as indicated on the contract drawing and referenced within the contract specifications.

B. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer.

C. Drain basins grates in hardscaped areas shall be ADA compliant. Drain basin grates in landscaped areas shall be standard grates.

D. The drain basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermoforming process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477. The pipe bell spigot shall be joined to the main body of the drain basin or catch basin. The raw material used to manufacture the pipe stock that is used to manufacture the main body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 cell class 12454.

E. The grates and frames furnished for all surface drainage inlets shall be ductile iron and shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for drain basins shall be capable of supporting various wheel loads as specified. Ductile iron used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05. Grates and covers shall be provided painted black.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 310000 "Earthwork."

3.2 PIPE INSTALLATION

A. Reinforced Concrete Pipe: The method of joining reinforced concrete pipe sections shall be such that the ends are fully entered, and the inner surfaces are reasonably flush and even. Joints shall be made with rubber gaskets and Portland Cement grout. The completed joints shall be protected against rapid drying by suitable covering material.

B. Use only nylon-protected slings to handle pipe. The use of hooks or bare cables will not be permitted.

C. PVC Piping: No machinery shall directly contact the PVC pipe to push the pipe into place. The pipe shall be pushed into place by hand. The use of a hammer or mallet is permitted, with the use of a board to shield the end of the pipe being struck by the hammer. The pipe shall not be directly contacted with a hammer or mallet. Any pipe damaged while being pushed into place or while being laid in the trench shall be removed from the site and replaced at the expense of the Contractor.

D. Pipe shall be inspected before any backfill is placed. Any pipe determined by the Owner's Representative to be out of alignment, unduly settled, or damaged shall be taken up and re-laid or replaced at no additional cost to Owner.

E. General Locations and Arrangements: Drawing plans and details indicate location and arrangement of underground storm drainage piping. Install piping as indicated, following piping manufacturer's written instructions.

F. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

G. If conflicts between utilities, the Contractor shall stop work on the utilities, contact the Engineer, and await direction from the Engineer.

H. Install piping with 36-inch minimum cover unless otherwise specified on the Drawings.

I. Install piping with a minimum slope as specified on Drawings.

J. Install PVC piping according to ASTM D 2321, ASTM F 1668, and manufacturer's recommendations.

K. Install reinforced-concrete piping according to ASTM C 1479 and manufacturer's recommendations.

3.3 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from drain pipe to cleanout at grade. Cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

B. Set cleanout frames and covers in earth in a cast-in-place concrete block, 12 by 12 by 8 inches deep. Top of concrete block shall be laid 3" below finished grade. Top of frame shall be set flush with finish grade where laid in earth.

C. Set cleanout frames and covers in bituminous concrete and concrete pavement or slabs with tops flush with pavement surface. Top of concrete block shall be laid at the bottom of the bituminous binder course where laid in pavement surface.

3.4 MANHOLE INSTALLATION

A. Excavation and backfilling requirements for installation of manhole and catch basin structures shall be in accordance with the requirements as specified in Section 310000, Earthwork.

B. Manhole and catch basin barrel and cone sections shall be set so as to be vertical and in true alignment.

C. Where required for future connections, openings shall be cast in the manholes and catch basins at the proper location and shall be sealed with watertight brick bulkheads or plugs.

D. The inverts of all manholes shall be constructed of brick and formed to the details shown on the contract drawings.

E. Concrete Base Slabs for manholes and catch basins shall have a full thickness of 12 inches shall extend 6 inches beyond the outside walls.

F. Bottom riser sections of reinforced concrete manholes and catch basins may be either cast-in-place or precast concrete. The top edges, of cast-in-place bottom sections, shall be formed with a removable steel ring template designed to fit the tongue end of the precast riser sections.

G. Inverts: Where pipe alignment permits, and where directed by the Owner's Representative, the pipe shall be continued through the manhole and the top half carefully and evenly cut away. Where changes in alignment occur, unless otherwise authorized by the Engineer, inverts shall be constructed of brick and mortar with a smooth flow line and an even curve in accordance with the plans.

H. Joints: Pipe joints into manholes and catch basins shall be constructed in accordance with the details shown on the plans. Complete details of the boot manufacture and installation shall be submitted for approval. All areas around pipes passing through walls of manholes and catch basins shall be completely filled with waterproof cement mortar to tightly fill any space through which water can pass. All manhole and catch basin joints between sections shall be sealed with 1" diameter Butyl rubber sealant with hydraulic cement and coated with bitumastic sealant on the exterior.

I. Bricks shall be laid in a workmanlike manner, true to line, and the joints shall be carefully struck and pointed on the inside. Bricks shall be thoroughly wet when laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The outside of the brickwork shall be neatly plastered with ½" layer of cement mortar as the work progresses. The brickwork shall be satisfactorily bonded to the concrete and cast iron frame. No brick masonry shall be laid in water, or any water allowed to rise on the brickwork until the masonry has set for at least 24 hours.

J. Water-proofing: All exterior surfaces of manholes and catch basins shall receive at least one coat of asphalt water-proofing.

3.5 STORMWATER HYDRODYNAMIC SEPERATOR INSTALLATION

A. The stormwater treatment system shall be installed in strict accordance with the manufacturer's recommendations.

B. Excavation, bedding, backfill and compaction for the structure shall be as specified in Section 31 00 00, EARTHWORK.

C. The structure shall be watertight upon the completion of the installation.

3.6 AREA DRAIN INSTALLATION

A. Install according to manufacturer's requirements and specifications.

B. Set tops of grating frames and grates flush with finished surface, unless otherwise indicated.

C. The specified PVC surface drainage inlet shall be installed using conventional flexible pipe

backfill materials and procedures.

D. The backfill material shall be crushed stone or other granular material meeting the requirements of class 1 or class 2 material as defined in ASTM D2321. Bedding and backfill for surface drainage inlets shall be well placed and compacted uniformly in accordance with ASTM D2321.

E. The drain basin body will be cut at the time of the final grade. No brick, stone or concrete block will be required to set the grate to the final grade height.

F. For load rated installations, a concrete slab shall be poured under and around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors.

3.7 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. Use procedure below:

1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 48 inches below final grade. Fill manhole below this point with gravel borrow and compact to 92%
3. Backfill to grade according to Section 310000 - Earthwork.

3.8 IDENTIFICATION

A. Materials and their installation are specified in Section 310000 - Earthwork. Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.9 FIELD QUALITY CONTROL

A. 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. 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.
2. The Contractor shall, at his own expense, replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
3. The Contractor shall repair any defects or corrections required by the Owner's Representative.

3.10 CLEANING

A. The Contractor shall clean interior of piping and structures of dirt, debris, and superfluous materials prior to commencing work, during construction and prior to acceptance of stormwater drainage system.

B. The Contractor shall also clean downstream portions of the stormwater conveyance system which recovered silt deposits from the construction activity.

3.11 RECORD DRAWINGS

A. All installed underground utilities shall be designated on as-built drawings by the contractor of record and provided to the Owner and Engineer in AutoCAD electrical format prior to completion of the project. All as-built drawings, (underground and above ground) shall be dimensioned from permanent benchmarks such as existing buildings and include depths at various points throughout the extent of the work, and invert elevations at all structures.

END OF SECTION

APPENDICES

REPORT
FOR
ASBESTOS CONTAINING MATERIALS IDENTIFICATION
SURVEY
AT THE
NORTH READING FIRE STATION
NORTH READING, MASSACHUSETTS

PROJECT NO: 223 513.00

SURVEY DATE:
July 20, 2023

SURVEY CONDUCTED BY:

UNIVERSAL ENVIRONMENTAL CONSULTANTS
12 BREWSTER ROAD
FRAMINGHAM, MA 01702

UEC universal environmental consultants

July 21, 2023

Mr. William Hammer
Principal
HKT Architects
24 Roland Street, Suite 301
Charlestown, MA 02129

Reference: **Asbestos Containing Materials Identification Survey**
North Reading Fire Station, North Reading, MA

Dear Mr. Hammer:

Thank you for the opportunity for Universal Environmental Consultants (UEC) to provide professional services.

Enclosed please find the report for the Identification Survey for Asbestos Containing Materials at the North Reading Fire Station, North Reading, MA.

The inspection was performed by a Massachusetts licensed asbestos inspector Mr. Jason Becotte (AI-034963).

Please do not hesitate to call should you have any questions.

Very truly yours,

Universal Environmental Consultants

_____
Ammar M. Dieb
President

UEC:\223 513.00\Report.DOC

Enclosure

INTRODUCTION:
UEC has been providing comprehensive asbestos services since 2001 and has completed projects throughout New England. We have completed projects for a variety of clients including residential, commercial, industrial, and public and private schools. We maintain appropriate asbestos licenses and staff with a minimum of thirty-three years of experience.

As part of the proposed renovation project, UEC was contracted by HKT Architects to conduct an identification survey for accessible Asbestos Containing Materials (ACM) at the North Reading Fire Station, North Reading, MA. No roofing or destructive testing was performed and this report should not be used to fully renovate or demolish the building.

The scope of work included the inspection of accessible ACM, collection of bulk samples from materials suspected to contain asbestos and determination of types of ACM found. Bulk samples analyses for asbestos were performed using the standard Polarized Light Microscopy (PLM) in accordance with Environmental Protection Agency (EPA) standard. Bulk samples were collected by a Massachusetts licensed asbestos inspector Mr. Jason Becotte (AI-034963) and analyzed by a Massachusetts licensed laboratory Asbestos Identification Laboratory, Woburn, MA.

Samples results are attached.

FINDINGS:
The regulations for asbestos inspection are based on representative sampling. It would be impractical and costly to sample all materials in all areas. Therefore, representative samples of each homogenous area were collected and analyzed or assumed.

All suspect materials were grouped into homogenous areas. By definition, a homogenous area is one in which the materials are evenly mixed and similar in appearance and texture throughout. Per Massachusetts regulations, a homogeneous area shall be determined to be ACM based on findings that the results of at least one sample collected from that area shows that asbestos is present in an amount of 1 percent or greater. No other accessible suspect material was found during this survey. Hidden ACM may be found during demolition.

Number of Samples Collected
Thirty seven (37) bulk samples were collected from the following materials suspected of containing asbestos.

Type and Location of Material

1. Interior CMU caulking at Apparatus Bay
2. Interior CMU caulking at Apparatus Bay
3. Interior CMU caulking at stairwell door
4. Interior CMU caulking at second floor hallway
5. Wood fire door insulation at stairwell
6. Wood fire door insulation at stairwell
7. Interior CMU to brick caulking at Apparatus Bay
8. Interior CMU to brick caulking at Apparatus Bay
9. Joint compound at Apparatus Bay
10. Joint compound at Apparatus Bay
11. Joint compound at basement weight room
12. Joint compound at basement old generator room
13. Joint compound at second floor bunk room
14. Hard joint insulation at Apparatus Bay
15. Hard joint insulation at Apparatus Bay
16. Hard joint insulation at Apparatus Bay
17. Hard joint insulation at Apparatus Bay
18. Rough ceiling plaster at boiler room
19. Rough ceiling plaster at boiler room
20. Rough ceiling plaster at boiler room
21. Boiler exhaust insulation at boiler room

22. Boiler exhaust insulation at boiler room
23. Boiler exhaust insulation at boiler room
24. 1’ x 1’ Suspended acoustical ceiling tile at first floor office
25. 1’ x 1’ Suspended acoustical ceiling tile at first floor office
26. 2’ x 2’ Suspended acoustical ceiling tile type I at second floor day room
27. 2’ x 2’ Suspended acoustical ceiling tile type I at second floor day room
28. 2’ x 2’ Suspended acoustical ceiling tile type II at first floor dispatch
29. 2’ x 2’ Suspended acoustical ceiling tile type II at first floor dispatch
30. Old black mastic under carpet at first floor office
31. Old black mastic under carpet at first floor office
32. Old black mastic under carpet at first floor dispatch
33. Exterior window framing caulking
34. Exterior window framing caulking
35. Exterior window framing caulking
36. Exterior door framing caulking
37. Exterior door framing caulking

Samples Results

Type and Location of Material	**Sample Result**
1. Interior CMU caulking at Apparatus Bay	5% Asbestos
2. Interior CMU caulking at stairwell door	5% Asbestos
3. Interior CMU caulking at second floor hallway	5% Asbestos
4. Interior CMU caulking at second floor hallway	5% Asbestos
5. Wood fire door insulation at stairwell	40% Asbestos
6. Wood fire door insulation at stairwell	40% Asbestos
7. Interior CMU to brick caulking at Apparatus Bay	10% Asbestos
8. Interior CMU to brick caulking at Apparatus Bay	10% Asbestos
9. Joint compound at Apparatus Bay	2% Asbestos
10. Joint compound at Apparatus Bay	2% Asbestos
11. Joint compound at basement weight room	No Asbestos Detected
12. Joint compound at basement old generator room	2% Asbestos
13. Joint compound at second floor bunk room	2% Asbestos
14. Hard joint insulation at Apparatus Bay	2% Asbestos
15. Hard joint insulation at Apparatus Bay	2% Asbestos
16. Hard joint insulation at Apparatus Bay	2% Asbestos
17. Hard joint insulation at Apparatus Bay	2% Asbestos
18. Rough ceiling plaster at boiler room	No Asbestos Detected
19. Rough ceiling plaster at boiler room	No Asbestos Detected
20. Rough ceiling plaster at boiler room	No Asbestos Detected
21. Boiler exhaust insulation at boiler room	60% Asbestos
22. Boiler exhaust insulation at boiler room	40% Asbestos
23. Boiler exhaust insulation at boiler room	40% Asbestos
24. 1’ x 1’ Suspended acoustical ceiling tile at first floor office	No Asbestos Detected
25. 1’ x 1’ Suspended acoustical ceiling tile at first floor office	No Asbestos Detected
26. 2’ x 2’ Suspended acoustical ceiling tile type I at second floor day room	No Asbestos Detected
27. 2’ x 2’ Suspended acoustical ceiling tile type I at second floor day room	No Asbestos Detected
28. 2’ x 2’ Suspended acoustical ceiling tile type II at first floor dispatch	No Asbestos Detected
29. 2’ x 2’ Suspended acoustical ceiling tile type II at first floor dispatch	No Asbestos Detected
30. Old black mastic under carpet at first floor office	No Asbestos Detected
31. Old black mastic under carpet at first floor office	No Asbestos Detected
32. Old black mastic under carpet at first floor dispatch	No Asbestos Detected
33. Exterior window framing caulking	5% Asbestos
34. Exterior window framing caulking	5% Asbestos
35. Exterior window framing caulking	2% Asbestos

36. Exterior door framing caulking 2% Asbestos
37. Exterior door framing caulking 5% Asbestos

OBSERVATIONS AND RECOMMENDATIONS:
All asbestos abatement activities must be performed by a Massachusetts licensed asbestos abatement contractor under the supervision of Massachusetts licensed project monitor should renovations or demolitions activities disturb the ACM.

1. Interior CMU caulking was found to contain asbestos.
2. Wood fire door insulation was found to contain asbestos.
3. Interior CMU to brick caulking was found to contain asbestos.
4. Joint compound was found to contain asbestos.
5. Boiler exhaust insulation was found to contain asbestos.
6. Hard joint insulation was found to contain asbestos.
7. Window framing caulking was found to contain asbestos.
8. Door framing caulking was found to contain asbestos.
9. Insulation/rope within old boiler was assumed to contain asbestos.
10. Hidden generator exhaust insulation was assumed to contain asbestos.
11. Roofing material was assumed to contain asbestos.
12. Transite sewer pipe was assumed to exist and assumed to contain asbestos.
13. All other suspect materials were found not to contain asbestos.

COST ESTIMATES:
The cost includes removal and disposal of all accessible ACM and an allowance for removal of inaccessible or hidden ACM that may be found during the demolition or renovation project.

Location	Material	Approximate Quantity	Cost Estimate ($)
Various Locations	Interior CMU Caulking	700 LF	7,000.00
	Interior CMU/Brick Caulking	30 LF	3,000.00
	Wood Fire Doors	5 Total	1,500.00
	Hard Joint Insulation	60 Total	1,800.00
	Joint Compound	7,000 SF	49,000.00
	Boiler Exhaust Insulation	80 SF	2,500.00
	Old Boiler	1 Total	7,500.00
	Generator Exhaust Insulation	20 LF	2,500.00
	Hidden/Unknown ACM	Unknown	8,500.00
	Various Hazardous Materials	Unknown	8,100.00
Exterior	Windows	30 Total	15,000.00
	Doors	4 Total	1,600.00
Estimated costs for Design, Construction Monitoring and Air Sampling Services			22,000.00
		TOTAL:	***130,000.00***

DESCRIPTION OF SURVEY METHODS AND LABORATORY ANALYSES:
Asbestos samples were collected using a method that prevents fiber release. Homogeneous sample areas were determined by criteria outlined in EPA document 560/5-85-030a.

Bulk material samples were analyzed using PLM and dispersion staining techniques in accordance with EPA/600/R-93/116 method.

LIMITATIONS AND CONDITIONS:
This report has been completed based on visual and physical observations made and information available at the time of the site visit, as well as information provided by the client. This report is intended to be used as a summary of available information on existing conditions with conclusions based on a reasonable and knowledgeable review of evidence found in accordance with normally accepted industry standards, state, and federal protocols, and within the scope and budget established by the client. Any additional data obtained by further review must be reviewed by UEC and the conclusions presented herein may be modified accordingly.

This report and attachments, prepared for the exclusive use of client for use in an asbestos evaluation of the subject site, are an integral part of the inspections and opinions should not be formulated without reading the report in its entirety. No part of this report may be altered, used, copied, or relied upon without prior written permission from UEC, except that this report may be conveyed in its entirety to parties associated with Owner for this subject study.

Asbestos Identification Laboratory.

165 New Boston St., Ste 227
Woburn, MA 01801
781-932-9600

Web: www.asbestosidentificationlab.com Email: mikemanning@asbestosidentificationlab.com

NVLAP® Testing Lab Code: 200919-0

Batch: 100832

Ammar Dieb
Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702

Project Information

152 Park St,
N Reading MA

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

Dear Ammar Dieb,

Asbestos Identification Laboratory has completed the analysis of the samples from your office for the above referenced project. The Analysis Method is BULK PLM ANALYSIS, EPA/600/R-93/116The information and analysis contained in this report have been generated using the EPA /600/R-93/116 Method for the Determination of Asbestos in Bulk Building Materials. Materials or products that contain more than 1% of any kind or combination of asbestos are considered an asbestos containing building material as determined by the EPA. This Polarized Light Microscope (PLM) technique may be performed either by visual estimation or point counting. Point counting provides a determination of the area percentage of asbestos in a sample. If the asbestos is estimated to be less than 10% by visual estimation of friable material, the determination may be repeated using the point counting technique. The results of the point counting supersede visual PLM results. Results in this report only relate to the items tested. This report may not be used by the customer to claim product endorsement by NVLAP or any other U.S. Government Agency.
Laboratory results represent the analysis of samples as submitted by the customer. Information regarding sample location, description, area, volume, etc., was provided by the customer. Asbestos Identification Laboratory is not responsible for sample collection activities or analytical method limitations. Unless notified in writing to return samples, Asbestos Identification Laboratory discards customer samples after 30 days. Samples containing subsamples or layers will be analyzed separately when applicable. Reports are kept at Asbestos Identification Laboratory for three years. This report shall not be reproduced, except in full, without the written consent of Asbestos Identification Laboratory.

- NVLAP Lab Code: 200919-0
- Massachusetts Certification License: AA000208
- State of Connecticut, Department of Public Health Approved Environmental Laboratory Registration Number: PH-0142
- State of Maine, Department of Environmental Protection Asbestos Analytical Laboratory License Number: LB-0078(Bulk) LA-0087(Air)
- State of Rhode Island and Providence Plantations. Department of Health Certification: AAL-121
- State of Vermont, Department of Health Environmental Health License AL934461

Thank you Ammar Dieb for your business.

Michael Manning
Owner/Director

Ammar Dieb
Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702

Project Information

152 Park St,
N Reading MA

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
1 / 1106494	Interior Caulk at CMU	Apparatus Bay Window	white	Non-Fibrous 95	Detected Chrysotile 5
2 / 1106495	Interior Caulk at CMU	Apparatus Bay Door	white	Non-Fibrous 95	Detected Chrysotile 5
3 / 1106496	Interior Caulk at CMU	Stairwell Door	white	Non-Fibrous 95	Detected Chrysotile 5
4 / 1106497	Interior Caulk at CMU	2nd Fl Hallway Door	white	Non-Fibrous 95	Detected Chrysotile 5
5 / 1106498	Word Fire Door Insulation	Stairwell	multi	Non-Fibrous 60	Detected Chrysotile 10 Amosite 30
6 / 1106499	Word Fire Door Insulation	Stairwell	multi	Non-Fibrous 60	Detected Chrysotile 10 Amosite 30
7 / 1106500	CMU to Brick Caulk	Apparaus Bay Front Wall	gray	Non-Fibrous 90	Detected Chrysotile 10
8 / 1106501	CMU to Brick Caulk	Apparaus Bay Front Wall	gray	Non-Fibrous 90	Detected Chrysotile 10
9 / 1106502	Joint Compound	Apparaus Bay Ceiling	white	Non-Fibrous 98	Detected Chrysotile 2
10 / 1106503	Joint Compound	Apparaus Bay Ceiling	white	Non-Fibrous 98	Detected Chrysotile 2
11 / 1106504	Joint Compound	Basement Weight Room Ceiling	white	Non-Fibrous 100	None Detected
12 / 1106505	Joint Compound	Basement Old Generator Room Ceiling	white	Non-Fibrous 98	Detected Chrysotile 2
13 / 1106506	Joint Compound	2nd Fl Burk Room Ceiling	tan	Non-Fibrous 98	Detected Chrysotile 2
14 / 1106507	Hard Joint Pipe Insulation	Apparatus Bag	gray	Fiberglass 20 Mineral Wool 30 Non-Fibrous 48	Detected Chrysotile 2
15 / 1106508	Hard Joint Pipe Insulation	Apparatus Bag	gray	Fiberglass 20 Mineral Wool 30 Non-Fibrous 48	Detected Chrysotile 2
16 / 1106509	Hard Joint Pipe Insulation	Apparatus Bag	gray	Fiberglass 20 Mineral Wool 30 Non-Fibrous 48	Detected Chrysotile 2

Sampled: July 20, 2023 **Received:** July 20, 2023 **Analyzed:** July 20, 2023

Friday 21 July 2023

Analyzed by:

Batch: 100832

Ammar Dieb
Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702

Project Information

152 Park St,
N Reading MA

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
17 / 1106510	Hard Joint Pipe Insulation	Basement	gray	Fiberglass 20 Mineral Wool 30 Non-Fibrous 48	**Detected** **Chrysotile 2**
18 / 1106511	Rough Ceiling Plaster	Boiler Room	white	Non-Fibrous 100	None Detected
19 / 1106512	Rough Ceiling Plaster	Boiler Room	white	Non-Fibrous 100	None Detected
20 / 1106513	Rough Ceiling Plaster	Boiler Room	white	Non-Fibrous 100	None Detected
21 / 1106514	Boiler Exhaust Insulation	Boiler Room	gray	Non-Fibrous 40	**Detected** **Chrysotile 60**
22 / 1106515	Boiler Exhaust Insulation	Boiler Room	white	Non-Fibrous 60	**Detected** **Chrysotile 40**
23 / 1106516	Boiler Exhaust Insulation	Boiler Room	white	Non-Fibrous 60	**Detected** **Chrysotile 5** **Amosite 35**
24 / 1106517	1x1 Spline AT Ceiling	1st Fl Office	gray	Fiberglass 40 Mineral Wool 50 Cellulose 5 Non-Fibrous 5	None Detected
25 / 1106518	1x1 Spline AT Ceiling	1st Fl Office	gray	Fiberglass 40 Mineral Wool 50 Cellulose 5 Non-Fibrous 5	None Detected
26 / 1106519	2x2 SAT	2nd Fl Day Room	gray	Fiberglass 20 Mineral Wool 30 Cellulose 40 Non-Fibrous 10	None Detected
27 / 1106520	2x2 SAT	2nd Fl Day Room	gray	Fiberglass 20 Mineral Wool 30 Cellulose 40 Non-Fibrous 10	None Detected
28 / 1106521	2x2 SAT Recessed	1st Fl Dispatch	gray	Fiberglass 20 Mineral Wool 30 Cellulose 40 Non-Fibrous 10	None Detected
29 / 1106522	2x2 SAT Recessed	1st Fl Dispatch	gray	Fiberglass 20 Mineral Wool 30 Cellulose 40 Non-Fibrous 10	None Detected
30 / 1106523	Old Black Mastic	1st Fl Office under Carpet	black	Non-Fibrous 100	None Detected

Sampled: July 20, 2023 **Received:** July 20, 2023 **Analyzed:** July 20, 2023

Friday 21 July 2023

Analyzed by:

Batch: 100832

Ammar Dieb
Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702

Project Information

152 Park St,
N Reading MA

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
31 / 1106524	Old Black Mastic	1st Fl Office under Carpet	black	Non-Fibrous 100	None Detected
32 / 1106525	Old Black Mastic	1st Fl Dispatch Under Raised Floor	black	Non-Fibrous 100	None Detected
33 / 1106526	Window Frame Caulk	Exterior Window	gray	Non-Fibrous 95	Detected Chrysotile 5
34 / 1106527	Window Frame Caulk	Exterior Window	gray	Non-Fibrous 95	Detected Chrysotile 5
35 / 1106528	Window Frame Caulk	Exterior Window	gray	Non-Fibrous 98	Detected Chrysotile 2
36 / 1106529	Door Frame Caulk	Exterior Door	multi	Non-Fibrous 98	Detected Chrysotile 2
37 / 1106530	Door Frame Caulk	Exterior Door	multi	Non-Fibrous 95	Detected Chrysotile 5

Sampled: July 20, 2023 **Received:** July 20, 2023 **Analyzed:** July 20, 2023

Friday 21 July 2023

Analyzed by:

Batch: 100832

CHAIN OF CUSTODY

Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702
Tel: (508) 628-5486 - Fax: (508) 628-5488
adieb@uec-env.com

PLM

24-hour TAT

Town/City: North Reading, MA Building Name Fire Department 152 Park St.

Sample	Description of Material	Sample Location
1	Interior caulk at CMU	Apparatus bay window
2	" "	Apparatus bay door
3	" "	Stair well door
4	" "	2nd fl. Hallway door
5	wood fire door Insulation	stair well
6	" "	" "
7	CMU to Brick caulk	Apparatus bay front wall
8	" "	" "
9	Joint Compound	Apparatus bay ceiling
10	" "	" "
11	" "	Basement weight room ceiling
12	" "	Basement old generator room ceiling
13	" "	2nd fl. Bunk room ceiling
14	Hard Joint pipe Insulation	Apparatus Bay
15	" "	" "
16	" "	" "
17	" "	Basement
18	Rough ceiling plaster	Boiler room
19	" "	" "
20	" "	" "

Reported By: Jason Berube Date: 7-20-23

Due Date: **24-Hours**

Received By: [signature] Date: 7/20/23

CHAIN OF CUSTODY

PLM

Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702
Tel: (508) 628-5486 - Fax: (508) 628-5488
adieb@uec-env.com

Town/City: North Reading, MA Building Name Fire Department 152 Park St.

Sample	Description of Material	Sample Location
21	Boiler exhaust Insulation	Boiler room
22	"	"
23	"	"
24	1x1 spline AT ceiling	1ST Fl. office
25	"	"
26	2x2 SAT	2nd Fl. Day Room
27	"	"
28	2x2 SAT Recessed	1st Fl. Dispatch
29	"	"
30	Old Black mastic	1ST Fl. office under carpet
31	"	"
32	"	1ST Fl. Dispatch under Raised Floor
33	window Frame caulk	exterior window
34	"	"
35	"	"
36	Door Frame Caulk	exterior Door
37	"	"

Reported By: Jason Beattie Date: 7-20-23

Due Date: **24-Hours**

Received By: [signature] Date: 7/20/23

HKT Architects

GEOTECHNICAL DESIGN BASIS REPORT

North Reading Fire Station Renovation Design

21123.01

Submitted May 23,, 2023 by:

PARE CORPORATION

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1.0 BACKGROUND/SITE LOCATION

This Geotechnical Design Basis Report presents the results of the geotechnical subsurface investigations and evaluations performed by Pare Corporation (Pare) at the site of the proposed addition to the North Reading Fire Station in North Reading, MA. The project site is depicted on Figure 1: Locus Plan and Figure 2: Aerial Plan. This report has been prepared in general accordance with our proposal and is subject to the Geotechnical Limitations presented in Appendix C.

1.1 Purpose and Scope

The purpose of this study was to identify the existing subsurface conditions within the area of the proposed addition; evaluate potential implications the observed conditions may have upon the proposed structures; and provide geotechnical parameters and recommendations for use during the design of the proposed project. The scope of work was performed in general accordance with Pare's proposal.

The scope of this evaluation did not include an evaluation of the site for the presence of contamination or other environmental concerns, as those tasks are outside the scope of this geotechnical report.

1.2 Background

Pare Corporation (Pare) understands that the proposed additions consist of two additions at the rear of the existing building and one expansion in front of the bay doors at the North Reading Fire Station in North Reading, MA. The existing building will also be structurally altered to support a new second floor at the existing low roof and front gable roof areas. The site improvements will be limited utility, stormwater and access improvements within the currently paved site.

The finished floor elevation (FFE) is anticipated to be at the FFE elevation of the existing North Reading Fire Station building. Elevations presented within this report are based upon a handheld GPS with sub-foot accuracy.

1.3 Surface Conditions

The general existing landscape of the proposed building addition footprint is surfaced by bituminous pavement in good condition that is currently used as parking for the existing fire station. The station is bordered by Park Street to the north and a wetland/swamp to the south, to the west and east exists medium to large sized trees as well as residential properties. The North Reading Fire Station slopes down from North to South with an elevation difference of approximately 10 feet. Utilities such as drainage lines, gas, cable, telephone and water lines are

Figure 1 Approximate Proposed Addition to North Reading Fire Station

present in the southern portion of the proposed building additions.

1.4 USGS Surficial/Bedrock Geology

The 2018 USGS surficial geology map indicated the site to be underlain by fine glacial stratified deposits across the site. These fine deposits "include very fine sand, and clay accruing as well-sorted, thin layers of alternating silt and clay, or as thick layers of very fine sand and silt. Very fine to fine sand commonly occurs at the surface of the lake bottom deposits and grades downward into rhythmically bedded silt and clay varves." Areas of boulders were not observed to be located in close proximity to the site.

The 1983 bedrock geology map of this area indicates that the surficial deposits are underlain by Sharpners Pond Diorite. Sharpners Pond Diorite is a non-foliated, medium-grained rock that contains diorite, tonalite, biotite-hornblende and small amounts of granodiorite.

1.5 Previous Site Development

Historical topographical maps and aerial plans were reviewed as part of site research, and are summarized as follows:

1. An 1868 map, earliest available mapping of the area on the USGS server, shows that the area confined by a river to the south to what is the swamp region in the present day. A railroad line is present to the South of the river to what is now known as Railroad Ave.

Photo 2: 1868 Topographical map

2. A 1951 map shows the development of Park St to the North of the site. The river has developed into a swamp area that is seen in the present day. The previously seen railroad track has been removed.

Photo 3: 1951 Topographical map

3. A 1987 map shows the existing Fire Station as well as the development of the park to the north of the site.

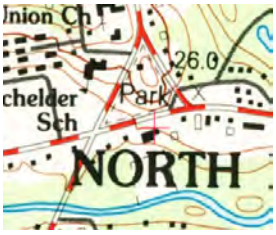


Photo 4: 1987 Topographical map

4. Google Earth Imagery from 2022 provides a view of the North Reading Fire Station. Park Street and the park are to the North, with the swamp to the south and trees to the west and east. The North Reading Fire Station appears to be in a similar condition.

Photo 5: 2022 Google Earth Imagery

2.0 SUBSURFACE EXPLORATIONS

A subsurface exploration program consisting of three (3) borings was performed to determine the subsurface conditions at the site in order to provide geotechnical information for the design of the proposed additions. Logs of the borings were completed and are included in Appendix A. Their locations are shown on Figure 3: Subsurface Exploration Plan.

The borings were completed by New England Boring Company of Derry, New Hampshire and observed by Pare personnel on March 16, 2023 through March 17, 2023. Soil borings were performed with a truck-mounted drill rig utilizing a 4-inch casing with wash and drive methods as noted on the boring logs. Pare personnel provided coordination and field observation of the borings performed. Field personnel observed the drilling conditions, visually identified the recovered samples during the advancement of the explorations and recorded approximate groundwater measurements.

2.1 Sampling Methodology

2.1.1 Borings

The sampling methodology for borings in soil consisted of obtaining disturbed samples of the deposits continuously for generally the first 15 feet, and at 5-foot intervals thereafter. The samples were during the performance of the Standard Penetration Test (SPT) in general accordance with ASTM D-1586. The SPT is used to obtain an indication of the characteristics, relative density, and consistency of the underlying soils. The test consists of driving a 1 3/8-inch inside-diameter split-spoon sampler for 24 inches with a 140-pound hammer dropping from a height of 30 inches. The SPT value used in analysis is the number of blows (N) required to drive the sampler from 6 to 18 inches of penetration.

During the explorations, subsurface soils were visually classified utilizing the Burmister Classification System. This system describes soil composition based upon the percentage of soil particle size present by weight in the sample with the major soil particle size listed first followed by other soil components described as “trace” indicating 0-10% by weight, “little” indicating 10-20% by weight, “some” indicating 20-35% by weight, or “and” indicating 35-50% by weight.

2.2 Field Measurement and Methodology

The locations of the soil borings were recorded using hand-held GPS equipment with sub-foot accuracy. The surface elevation at each boring was obtained using the hand-held GPS equipment.

2.3 Locations

The subsurface exploration program completed at the site included three (3) borings (B22-1 through B22-3) advanced to depths of 31.0 feet within the proposed building addition footprints. The locations and depths of each of the borings are summarized in Table 3-1: Subsurface Exploration Summary.

3.0 SUBSURFACE CONDITIONS

3.1 Subsurface Investigation Summary

Proposed Building Addition Footprint: The general stratigraphy for the proposed building footprint consists of FILL, overlaying FINE GLACIAL DEPOSITS.

Table 3-1: Subsurface Exploration Summary

Boring	General Location	Approx. Ground Surface Elevation (Feet)	Approximate Depth to Top (ft) / Thickness of Stratum (ft) (Top of Stratum Elevation)		Depth of Exploration (Feet)	Groundwater Depth (Feet)
			(Stratum 1) FILL	(Stratum 2) FINE GLACIAL DEPSOITS		
B23-1	Front of Fire Station	74.675	0.0/10.0	10.0/EOE	31.0 (EL. 43.675)	6.0 (EL. 68.675)
B23-2	Back of Fire Station	64.455	0.0/2.0	1.75/EOE	31.0 (EL. 33.455)	2.0 (EL. 62.455)
B23-3	Back of Fire Station	64.514	0.0/4.0	3.75/EOE	31.0 (EL. 33.514)	4.0 (EL. 60.514)

NE- Not Encountered
EOE- End of Exploration

3.2 Soil Strata

The various soil strata encountered in the borings are described as follows. It should be noted that the depths to, nature, and thickness of the various soil strata will vary between and away from the exploration locations.

Stratum 1 – FILL

FILL was encountered in borings B23-1 through B23-3. The FILL has a thickness ranging from 2.0 feet to 10.0 feet and can generally be described as moist to wet, brown, fine to medium SAND with “little” to “some” amounts of fine to coarse gravel, “trace” to “little” silt/clay, and “trace” amounts of roots and bricks. Each boring location is surfaced by approximately 3 inches of bituminous asphalt.

SPTs performed in Stratum 1 generally indicate a relative density of loose to medium dense.

Stratum 2 – FINE GLACIAL DEPSOITS

FINE GLACIAL DEPOSITS were encountered underlying the FILL in borings B23-1 through B23-3 and is generally described as wet, light brown, fine to medium SAND with “trace” to “and” amounts of silt/clay. FINE GLACIAL DEPSOITS are also described as wet, gray, SILT/CLAY, with “trace” to “little” amounts of gravel.

SPTs performed in Stratum 2 generally indicate a relative density of loose to dense.

3.3 Groundwater

Based on visual observations taken during the subsurface investigation program, groundwater varied from approximately 2.0 to 6.0 feet below the existing ground surface with elevations ranging from 60.5 feet to 68.7 feet.

It is important to note that as part of the boring activities, water was introduced to each borehole and may not have dissipated at the time that the initial or subsequent measurements were taken. Please see the boring logs within Appendix A of this report for details on groundwater depths.

It should be noted that groundwater levels are known to fluctuate due to local and regional factors including, but not limited to, precipitation events, seasonal changes, and periods of wet or dry weather.

4.0 LABORATORY TESTING

4.1 Soil Testing

4.1.1 Grain Size Analysis

The soil testing included three mechanical grain size upon soil samples from the strata encountered during the investigation. The tests were performed according to ASTM D-6913. The results of the tests are presented as follows:

Table 4-1: Results of Grain Size Analyses

Test No.	Boring No.	Sample No.	Depth (Ft.)	Representative Soil Strata	%Gravel	% Sand	% Fines
1	B22-1	S-9	19-21	FINE GLACIAL DEPOSITS	0.9	96.5	2.6
2	B22-2	S-11	29-31	FINE GLACIAL DEPOSITS	20.5	58.9	20.6
3	B22-3	S-4	6-8	FINE GLACIAL DEPOSITS	0.5	97.3	2.3

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Site Preparations

The design of the site preparation program should be coordinated with the project design team in discussion with the geotechnical engineer and the site/civil engineer.

The following summarizes the general site preparation approach to provide suitable bearing for spread footings, foundations, and pavements.

- Due to the high percentage of fine sand, silt and clay sized particles in the soils present below the surface of the site, crushed stone used under foundations, slabs, or around utilities should be wrapped with geotextile filter fabric when backfilled with existing site soils to prevent the migration of the fine particles into the voids within the crushed stone. The filter fabric specification should be designed for site specific soils.

- FILL was encountered within borings B23-1 through B23-3 from the surface to approximately 10 feet below ground surface. Subgrades for foundations should be excavated through the fill stratum to provide structures to bear on the FINE GLACIAL DEPOSITS stratum as FILL is NOT a suitable bearing stratum.

- Unsuitable in-situ soils: FILL, and other soils not identified in the subsurface investigation but are found to contain organic matter, roots, construction debris, and/or other deleterious materials should be over-excavated within the influence zone of the proposed shallow foundation and slabs-on-grade to the top of the FINE GLACIAL DEPOSITS, or other soil layer determined to be an acceptable bearing stratum as determined by a geotechnical engineer. FILL is recommended to be removed and/or modified as specified herein.

- Subgrades in FINE GLACIAL DEPOSIS should be over-excavated by 12 inches and backfilled with a compacted 12-inch “cushion” of “Sand Gravel Fill”, or over-excavated by 6 inches and backfilled using wrapped crushed stone.

- FINE GLACIAL DEPOST subgrades should be proof rolled and or minimum 4-6 perpendicular passes of a vibratory and/or static roller with a static weight of 10,000 pounds and a dynamic weight of 20,000 pounds. Caution should be used when compacting the subgrade, if wet or near adjacent construction, to avoid weaving and disturbance from vibrations.

- BOULDERS were not encountered within the FILL or FINE GLACIAL DEPOSITS. While excavation of overburden soils can be completed with excavators, if any large boulders are encountered, hammering of the boulders to facilitate removal should be anticipated. Boulders exposed on the surface of the subgrade larger than 6-inches should be removed and the resulting voids filled with compacted “Granular Fill”.

- Excavations should be backfilled with approved material, compacted in lifts, to the bearing elevation of the proposed subgrade or slabs-on-grade.

- Groundwater was encountered 2.0 feet to 6.0 feet below the existing grade. Within the proposed building addition footprint, the groundwater elevations range from 60.51 feet to 68.68 feet. Construction and permanent dewatering should be anticipated within the footprint of the building additions.

5.2 Frost Depth Recommendations

In conformance with the 9th Edition of Massachusetts CMR 780, exterior footings found over soils should be placed at a minimum depth of 48 inches below the finished grade in order to provide frost protection. Preparation for slabs and paved areas should consider the frost heave susceptibility of subgrade soils.

5.3 Seismic Design Category and Liquefaction Evaluations

5.3.1 Site Criteria

In general accordance with the 2018 International Building Code, 9th Edition of Massachusetts 780 CMR, based on the boring information the soil profile of the project site is characterized as Site Class Profile D, "Stiff Soil" (i.e. 15<N<50)

The Site Risk Category was determined to be Category IV.

Based on Massachusetts 780 CMR 9th Edition, Table 1604.11, the maximum considered earthquake spectral response acceleration at short periods, S_s, and at 1-second periods, S_1, are 0.24 g and 0.073 g respectively. Correcting the accelerations for the observed site profile based upon average Standard Penetrations Test N values, the following parameters are recommended by the general procedure:

- Adjusted maximum considered earthquake spectral response acceleration parameters:
  - S_{MS} = 0.384
  - S_{M1} = 0.176
- For calculating the design spectral response accelerations, utilize:
  - S_{DS} = 0.256
  - S_{D1} = 0.118
- PGAm= 0.204
- Seismic Design Category: B

5.3.2 Liquefaction Evaluation

Liquefaction is the tendency for a soil type, particularly fine sands, to lose a significant amount of strength and behave similar to a liquid in the event of an earthquake, or sufficient vibrations. Liquefaction analyses generally relate SPT N values, corrected for overburden, fines content, and measured groundwater levels to the liquefaction potential of the materials in question. In general, in order for liquefaction to occur three conditions have to be met simultaneously. These are: 1.) loose sandy soils susceptible to liquefaction, 2.) saturated soil conditions, and 3.) vibration.

The liquefaction analyses completed during the preparation of this report takes into account the soil and groundwater conditions encountered during the subsurface exploration program. It should be noted that fluctuations in groundwater levels can have a significant effect on the liquefaction potential of soils. If the groundwater is observed to change during the construction process or future explorations, Pare should be contacted as it may be necessary to re-analyze the soil for liquefaction potential.

Based upon the observed relative densities, groundwater elevation and material composition, it appears that the in-situ soils are NOT susceptible to liquefaction at this time.

5.4 Foundations

Based on the findings of this report, Pare's recommendation for the foundation of the proposed additions to the North Reading Fire Station is a shallow foundation in Stratum 2.

Several foundation alternatives were evaluated for supporting the proposed building addition. Items considered in the evaluation included the assumed structure loading, soil conditions, foundation elevation, and tolerable structure movement.

5.4.1 Shallow Foundations

For the proposed structures, a shallow foundation system composed of wall (i.e., continuous) footings bearing on a minimum 12-inch thick layer of compacted "Sand Gravel Fill" or 6-inches of crushed stone laced on compacted structural "Granular Fill" or proof-compacted FINE GLACIAL DEPOSITS are recommended for effectively transferring the building loads to the ground. Assuming that differential settlement between the existing building and addition is limited to ½ inch, a maximum total settlement of ½ inch is allowable for the addition. Based on these assumptions, ***a maximum net allowable soil bearing pressure[1] of 3,000 pounds per square foot is recommended in the design footings bearing on FINE GLACIAL DEPOSITS, "Sand and Gravel Fill", and "Gravel Fill".*** The continuous footings were assumed to be at least 4 feet wide and maximum 6 feet wide; In the event that lower displacement tolerances are required, Pare should be contacted to revise the bearing pressure, subgrade preparation, and/or foundation recommendations. Settlement limitations may change based upon the structural design team's verification of the proposed structures settlement tolerances.

Footings should be proportioned to apply no more than the net allowable bearing pressure. For continuous footings less than 4-feet wide or greater than 6-feet wide, the net allowable bearing pressure should be reassessed.

5.4.2 Pavement Foundations

The FINE GLACIAL DEPOSITS appears suitable as a pavement subgrade as required by MassDOT specifications. Compaction and preparation of the subgrade will be required to meet

[1] Net allowable bearing pressure is the pressure in excess of the existing overburden pressure that can be safely carried at the footing depth, D (based on presumptive bearing capacities).

MassDOT specifications. Due to the high silt content of the FINE GLACIAL DEPOSITS, the OWNER should be made aware of the potential risk for frost heave with the re-use of this material.

5.4.3 Lateral Earth Pressures and Retaining Wall Design

For the design of retaining walls with level backfill, recommended lateral earth pressure coefficients are indicated in Table 5-1. A moist unit weight of 125 pounds per cubic foot (pcf) and a minimum internal friction angle (ϕ) of 35° for imported free draining "Granular Fill" is assumed. The lateral earth pressure coefficient should be increased where the ground surface slopes up behind the wall. The retaining walls should be designed to withstand surcharge loading which may be present over the life of the structure. These would include traffic loads, as well as loads from storage, fill or construction equipment which may be occur within the influence zone of the wall. The influence zone behind the wall can be defined by a 1.5 horizontal to 1 vertical line extending upward from the bottom outside edge of the wall footing.

The magnitude of lateral earth pressure against retaining walls is dependent upon the type of backfill, method of fill placement, drainage provisions, and the amount of displacement the wall is permitted to undergo after the placement of the backfill. Pare recommends that the retaining walls be backfilled with a free draining compacted "Granular Fill", as defined herein.

The lateral earth pressure distribution against the retaining wall should be computed using the appropriate value of K, the coefficient of lateral earth pressure. Recommended values of K are presented in the table below. Friction factors are also presented for use in checking resistance to unbalanced forces on the walls.

Table 5-1: Recommended Earth Pressure and Friction Coefficients

Material	At-Rest Coefficient (K_o)	Active Coefficient (K_a)	Passive Coefficient (K_p)
Fill (Φ = 34°)	0.44	0.28	3.54
Fine Glacial Deposits (Φ = 35°)	0.43	0.27	3.69
Imported "Granular Fill" (Φ = 35°)	0.43	0.27	3.69
FRICTION COEFFICIENTS			
Concrete Poured on Imported Sand Gravel Fill			tan δ = 0.45
Precast Concrete on Imported Sand Gravel Fill			tan δ = 0.30

5.5 Drainage

Based on observations taken during the subsurface investigation, groundwater was encountered at depths ranging from approximately 2.0 to 6.0 feet below the existing ground surface with elevations ranging from 60.5 feet to 68.7 feet. Temporary dewatering during construction will be required.

Due to the high percentage of fine sand, silt, and clay sized particles in the soils present below the surface of the site. Construction activities may be impacted by flooding from storm events that occur if proper precautions are not performed to manage runoff. *Temporary dewatering to control stormwater runoff, and potential groundwater seepage into excavations is anticipated.*

Bearing surfaces should be prepared in the dry condition. Surface water runoff should be directed

away from the excavations. As water levels are anticipated to fluctuate with the seasons and precipitation events, positive drainage is also recommended in order to carry water away from the excavations.

5.6 Underground Utilities

Underground pipes and utilities should be placed on bedding in accordance with the manufacturer's specifications and recommendations. "Granular Fill" should be placed in lifts on the sides and above the utilities. The lift's thickness should be sized appropriately for the equipment being used. For hand operated compaction equipment loose lift thickness should be limited to 6-inches; for vibratory plate compactors, 8-inch loose lifts; and for vibratory drum roller or sheep's foot trench roller, 12-inch loose lifts.

Flexible connections should be considered for utilities connected between the existing Fire Station building and the new addition due to potentially excessive differential settlements between the two.

5.7 Construction Materials

Fill materials should be free from trash, ice, snow, frozen soils, tree stumps, roots, and other organic matter and deleterious materials. Pare recommends the following soil gradations for imported fill, conforming to the Commonwealth Massachusetts Department of Transportation *Standard Specifications for Highway and Bridges 2021 Edition* (State Standards).

- Imported Gravel Borrow or on-site soil utilized as "Sand Gravel fill" below structures and under pavement should conform to M1.03.0 Type B of the State Standards and conforming to the material gradation in Table M1.03.0-1 of the State Standard.

- All other Imported Gravel Borrow material or on-site utilized as "Granular Fill" below structure and for material utilized in regrading areas, trench backfill, or backfill against below-grade wall as 'Granular Fill" should conform to M1.03.0 Type A and conforming to the material gradation in Table M1.03.0-1 of the State Standards.

- Crushed Stone Bedding Material should be imported material conforming to the material gradation in Table M2.01.7-1 of the State Standards.

5.8 Reuse of On-Site Soils

Based on the visual classifications, the onsite FILL may be suitable for reuse as loam in landscaped areas. All ASPHALT material should be disposed of off-site in accordance with local, state, and federal laws.

It should be noted that not all recommended materials will be available onsite in the quantities or gradations recommended. Imported materials will likely be required.

5.9 Soils Prone to Disturbance from Rain and Frost

Silty or fine sandy soils are prone to disturbance when saturated from rainfall events, these soils

will be easily disturbed by construction equipment traversing the site, are difficult to compact, and prone to frost heaves during freeze thaw cycles. The onsite FILL and FINE COARSE DEPOSITS are considered highly susceptible materials. If the construction is performed during the late fall, winter, or spring months, wet conditions and freeze thaw cycles should be expected to prevail. Soils becoming saturated or allowed to freeze will require re-compaction and retesting prior to placing additional fill material or structural components. Delays caused by wet/freezing soil conditions may be a factor that affects the construction schedule. Should the subgrade become disturbed, the disturbed material should be over-excavated and replaced with compacted "Granular Fill" as recommended in Section 6.

Soils with a silt content of greater than about 8% have the potential to heave when subjected to freezing conditions. The risk of heaving increases with increasing silt content, although soils with a silt content of less than about 15% silt is considered within the construction industry to be an acceptable risk. High silt content soils are not recommended for use in frost zones below structures, pavements, or within the influence zone of foundation walls due to their susceptibility to frost heave. Prior to reusing these materials, Confirmatory sieve analyses for each type of on-site material proposed for reuse should be completed by the Contractor and submitted to the project design team for approval.

5.10 Compaction

The approved subgrade to accept backfill and foundations should be compacted by proof compaction with at least six (6) passes of a 10-ton vibratory and/or static roller performed in perpendicular directions.

Lift thicknesses of placed approved material should be limited to 8-12 inches thick (loose lift thickness). Compaction of this material should be performed with adequately sized equipment to yield the recommended amount of relative compaction.

All fill should be compacted under the observation of the geotechnical engineer or their qualified representative to the minimum compaction requirements as presented in Table 5-2. Each lift of placed material should be field density tested in accordance with project specifications.

Table 5-2: Recommended Minimum Compaction Requirements

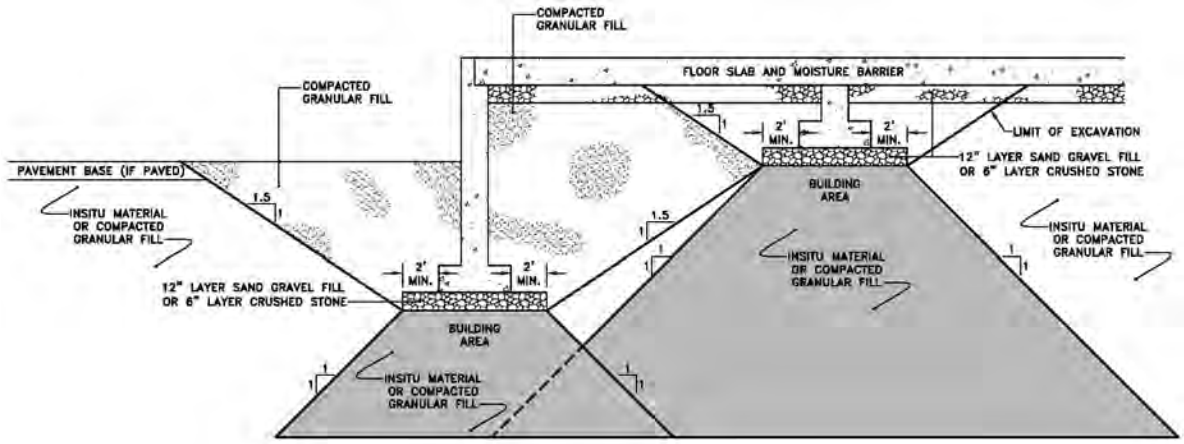
Location	Percent of Maximum Dry Density [1]
Backfill below foundations[2]	95
Backfill for foundation and retaining walls	95
Backfill within pavement base and subbase layers	95
Backfill below pavement subbase layers	95
Around and above utilities within structure areas	95
Around and above utilities in paved areas	95[3]
Backfill within landscaped areas	85

[1] Maximum dry density as determined by the Modified Proctor test (ASTM D 1557)

[2] Described as an area extending downward and outward from 2 feet outside of the outside edge of the foundation at a 1H:1V slope.

[3] Care shall be taken for the first foot of material placed above pipes to avoid damaging the conduit, utility or duct bank.

Figure 5-1: Typical Profile Below Footings



6.0 CONSTRUCTION CONSIDERATIONS

This section presents construction considerations and recommendations including excavation, backfilling, utility installation, dewatering, lateral earth support, protection of adjacent structures, and construction monitoring.

6.1 Excavation

6.1.1 Site Preparation

Building Addition Area: fter rough grades have been established, but before placement of compacted "Granular Fill", exposed surfaces should be visually inspected and probed. Frozen, wet, or loose soil and other undesirable materials should be removed.

Should the subgrade become disturbed during excavation and/or construction, all disturbed material should be over-excavated to firm or native soil and replaced with a minimum of one foot of compacted "Granular Fill" or "Crushed Stone" wrapped in geotextile filter fabric.

Groundwater was encountered between approximately 2 to 6 feet below the existing site grade. At these depths, groundwater may impact the excavations for the proposed infrastructure improvements. *Temporary dewatering to control groundwater inflow to excavations is anticipated.*

6.2 Backfilling

6.2.1 Gravel Borrow

Pare recommends that footings, foundation walls, and areas requiring fill below the floor slab be backfilled to within 12 inches of the bottom of the footing or slab with compacted "Granular Fill". Compacted "Granular Fill" should be free draining friable soil free from trash, ice, snow, tree stumps, roots, other organic matter, deleterious materials, and conform to the specified requirements.

In general, compaction should be accomplished by placing fill in 8 to 12 inch loose horizontal lifts and mechanically compacting each lift to the specified dry density. Thinner lifts may be required in certain instances depending on the type of mechanical compaction equipment utilized. Recommended minimum compaction requirements are described in Section 6.11.

6.2.2 Sand Gravel Fill / Crushed Stone

"Sand Gravel Fill" should be placed for the final 12 inches below footings, and as pavement base course layers. This material should be placed in 8 to 12 inch loose horizontal lifts and mechanically compacted to the specified dry density. In areas where wet conditions are encountered, "Crushed Stone" (wrapped in Geotextile Fabric) could be used under footings instead of the "Sand Gravel Fill". The "Crushed Stone" should be proof compacted with 3 passes in each direction with a vibratory and/or static compactor.

6.2.3 Excavation Backfill

When backfilling against excavated slopes or trench walls the Contractor should take care to bench the lift into the excavated slope wall. Compaction equipment should be operated in such a manner to achieve adequate bonding and compaction of the placed lift and existing excavation wall.

6.3 Excavation Support

The depth of excavation is expected to be up to approximately 2 to 10 feet below the existing ground surface to remove observed FILL stratum. A temporary earth support system may be required along existing structures. In areas not adjacent to existing structures and open cut excavation may be utilized. Where excavation should be scheduled such that construction can proceed systematically and safely to avoid detrimental effects (i.e., undermining, slope/excavation/existing structure instability) to the existing building structure. We recommend that the structural stability of the existing building is assessed by a licensed structural engineer before excavations are performed for the new additional structure. The maximum allowable slope shall be in accordance with OSHA recommendations.

In areas where open cut is possible without a temporary support system, the final side slopes should conform to Local, State, and Federal safety requirements.

Excavation support is solely the Contractor's responsibility. Due to the depths of the excavations and close proximity to adjacent structures, temporary earth support is anticipated for this project.

During the installation of the temporary earth support systems, consideration should be given to stabilizing the existing building structure and monitoring the existing building structure for movement.

6.4 Construction Sequencing

Construction should be sequenced to protect adjacent structures and prevent ponded water. Based on the subsurface exploration, groundwater may impact site excavations. See dewatering section for control of pond water during rain and surface runoff events.

6.5 Utility Installation

Excavations for installation of underground utilities should be made to comply with all OSHA, federal, state, and local regulations. At a minimum, excavations should be wide enough to accommodate the utility to be installed with clearance on each side of the utility to provide space for operating compaction equipment for backfilling of the utility in lifts without damaging the utility. The base of the excavation and bedding layer should be formed to properly support all components of the utility, including pipe bells, and manholes to prevent damage during installation. During backfilling operations, care should be taken to provide properly compacted fill along the length of the utility being installed. All fill material in excess of 3 inches (including cobbles and boulders within the native deposits) should be removed from the fill within 12 inches of the utility to prevent damage to the utility during compaction.

6.6 Dewatering

During construction, temporary dewatering will be required to control ponded water resulting from groundwater pooling, rain, and surface runoff. Based on measurements taken during the subsurface investigation, groundwater may be anticipated within the proposed excavation depths. The Contractor should provide for proper drainage of surface water away from any excavations. All excavations should be conducted in the dry.

It should be noted that groundwater levels may fluctuate over time due to variations in rainfall and other factors different from those prevailing at the time the explorations were performed.

6.7 Protection of Adjacent Structures

Pare recommends that prior to the start of construction, a video and/or photo pre-construction survey is performed at any buildings which are located near the work area which may be affected. This should also include adjacent utilities that may be affected by the construction. This survey would record "pre-construction-conditions" of existing structures and utilities that are expected to remain through construction. These surveys are invaluable in resolving potential project claim disputes.

Pare recommends that crack gauges be installed to monitor the movement of existing cracks and on any cracks that develop in new or existing walls.

6.8 Construction Monitoring

The site preparation, excavation and backfill, compaction, and foundation installations should be observed by registered professional engineers or their representatives experienced in geotechnical engineering. While onsite, the field engineer or qualified representative should provide field density testing, verification of bearing layers, and assistance in general interpretation of the geotechnical requirements during construction. This would provide an accurate record of construction, alert the designer to changed conditions, and make useful data available for upcoming construction.

Foundation excavations should be observed to confirm that all loose, soft, and undesirable material (i.e. organic matter, roots, and other deleterious materials) is removed and that the foundations will bear on a satisfactory material. Excavation subgrade observations should include hand auger borings or hand probing.

As mentioned, compaction criteria for the various imported materials should be developed and included in the specifications. Field density testing should be performed using a nuclear density gauge to confirm that adequate compaction is being achieved. During construction, representative samples of all materials to be used as backfill should also be tested for conformance with the specified material properties.

REFERENCES

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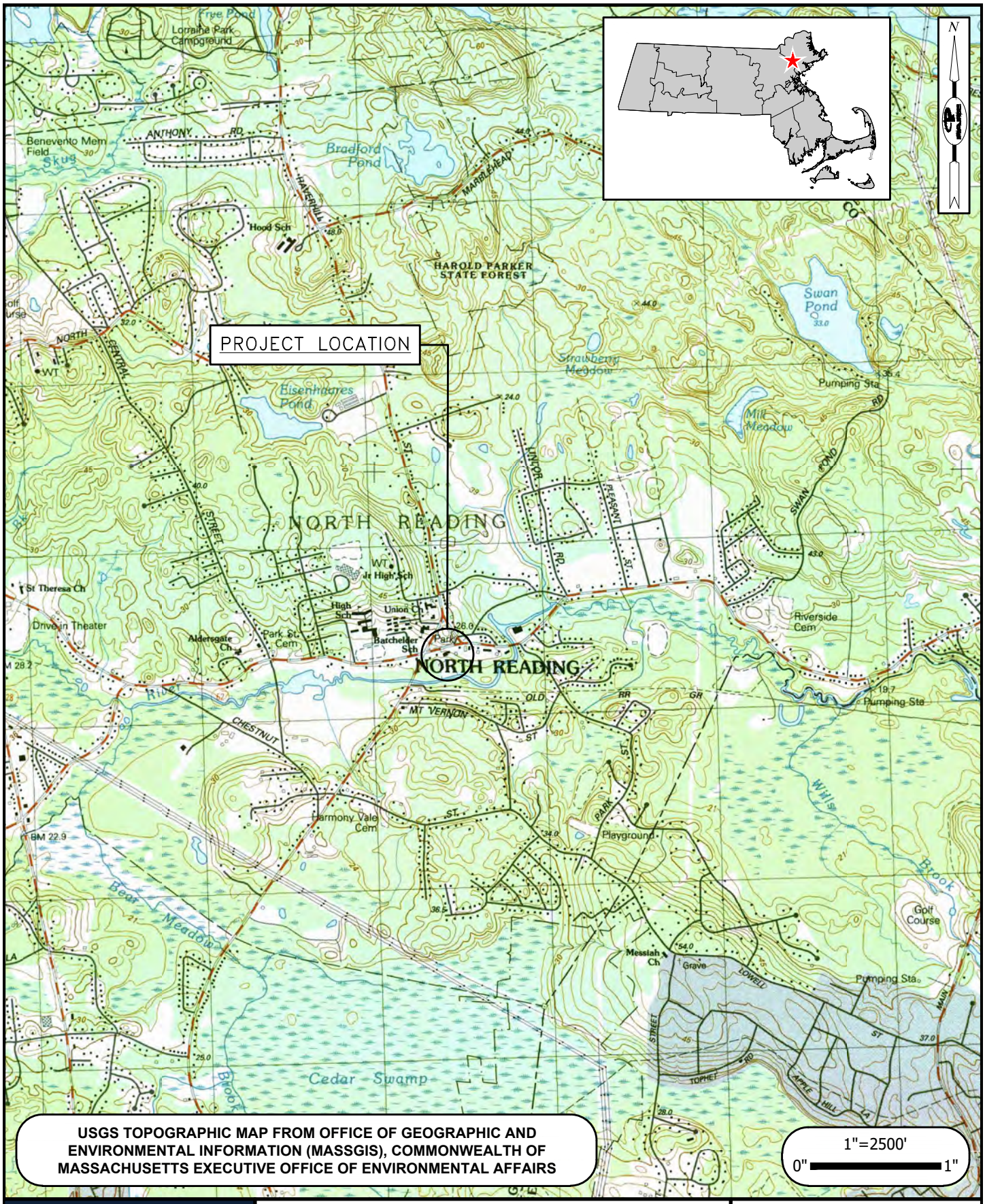
Figures

PARE CORPORATION



USGS TOPOGRAPHIC MAP FROM OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

PARE CORPORATION

NORTH READING FIRE STATION

152 PARK STREET

NORTH READING, MASSACHUSETTS

TOWN OF NORTH READING

LOCUS PLAN

MARCH 2023

FIGURE 1

PARE CORPORATION

NORTH READING FIRE STATION

152 PARK STREET

NORTH READING, MASSACHUSETTS

TOWN OF NORTH READING

AERIAL PLAN

MARCH 2023

FIGURE 2

SUBSURFACE EXPLORATION PLAN

SCALE: 1"=40'±

LEGEND

B23-1 BORINGS COMPLETED BY NEW ENGLAND BORING COMPANY ON MARCH 16 AND 17, 2023. BORINGS WERE OBSERVED BY PARE CORPORATION PERSONNEL.

NOTE:

PLAN DEVELOPED FROM AVAILABLE AERIAL IMAGERY FROM MASSGIS. INFORMATION IS PROVIDED FOR REFERENCE PURPOSES ONLY.

PARE
PARE CORPORATION
ENGINEERS · SCIENTISTS · PLANNERS
10 LINCOLN ROAD, SUITE 210
FOXBORO, MA 02035
508-543-1755

SCALE ADJUSTMENT GUIDE

0" 1"

BAR IS ONE INCH ON ORIGINAL DRAWING

NORTH READING FIRE STATION
152 PARK STREET
NORTH READING, MASSACHUSETTS
TOWN OF NORTH READING

REVISIONS:

PROJECT NO.:	21123.01
DATE:	MARCH 2023
SCALE:	AS NOTED
DESIGNED BY:	SF
CHECKED BY:	ARO
DRAWN BY:	LMC
APPROVED BY:	ARO

SUBSURFACE EXPLORATION PLAN

FIGURE NO.: 3

Y:\JOBS\21 Jobs\21123.01 NoReading-Fire Station Reno Design Ph-MA\DWGS\FIG 3 BORING PLAN.dwg

Appendix A:
Boring Logs

PARE CORPORATION

Pare Corporation
10 Lincoln Road, Suite 210
Foxboro, MA 02035
508-543-1755

BORING NUMBER B23-1

CLIENT HKT Architects
PROJECT NAME North Reading Fire Station Renovation Design
PROJECT NUMBER 21123.01
PROJECT LOCATION North Reading, MA
DATE STARTED 3/17/23 **COMPLETED** 3/17/23
GROUND ELEVATION 74.675 ft NAVD88 **HOLE SIZE** 4 in.
DRILLING CONTRACTOR New England Boring Contractors, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Wash and Drive with GT8 Versa Drill
AT TIME OF DRILLING 6.00 ft / Elev 68.68 ft
LOGGED BY SF **CHECKED BY** BCN
AT END OF DRILLING ---
BORING LOCATION Front of the Fire Station **N:** 3034488 **E:** 769912

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
0	74.7									
			S-1	10 / 24	0 - 2	45-59-30-21 (89)			Moist, very dense, dark brown to black, fine to medium SAND, little fine to medium gravel, trace silt/clay.	3" ASPHALT
			S-2	14 / 24	2 - 4	13-14-14-17 (28)			Moist, medium dense, brown, fine to medium SAND, little fine to medium gravel, trace silt/clay, trace plastic.	
5	69.7		S-3	8 / 24	4 - 6	7-9-4-3 (13)			Moist, medium dense, brown, fine to medium SAND, little fine to medium gravel, trace silt/clay, trace plastic.	FILL
			S-4	6 / 24	6 - 8	2-9-12-12 (21)			Wet, medium dense, brown, fine to medium SAND, little fine to medium gravel, little silt/clay.	
10	64.7		S-5	10 / 24	8 - 10	18-7-12-31 (19)			Wet, medium dense, brown to black, fine to medium SAND, some fine to coarse gravel, little silt/clay.	
			S-6	10 / 24	10 - 12	9-7-3-7 (10)			Wet, loose, light brown, fine to medium SAND, little silt/clay.	FINE GLACIAL DEPOSITS
			S-7	11 / 24	12 - 14	10-11-13-19 (24)			Wet, medium dense, light brown, fine to medium SAND, trace silt/clay.	
15	59.7		S-8	19 / 24	14 - 16	14-15-16-20 (31)			Wet, dense, light brown, mostly fine SAND, trace silt/clay.	
20	54.7		S-9	19 / 24	19 - 21	9-12-12-12 (24)			Wet, medium dense, light brown, fine to medium SAND, trace silt/clay.	
25	49.7		S-10	2 / 24	24 - 26	21-16-12-11 (28)			Wet, medium dense, brown, fine to medium SAND, trace fine to medium gravel, trace silt/clay.	
30	44.7		S-11	13 / 24	29 - 31	16-14-12-16 (26)			Wet, medium dense, light brown, fine to medium SAND, little silt/clay, trace fine to medium gravel.	
35									Bottom of borehole at 31.0 feet.	

GRANULAR SOILS

BLOWS/FT	DENSITY
0 - 4	V. LOOSE
4 -10	LOOSE
10 - 30	M. DENSE
30 - 50	DENSE
>50	V. DENSE

COHESIVE SOILS

BLOWS/FT	CONSIST.
<2	V. SOFT
2 - 4	SOFT
4 - 8	M. STIFF
8 - 15	STIFF
15 - 30	V. STIFF
>30	HARD

REMARKS:
1.Rollerbit through top 3" of asphalt.

BURMISTER CLASSIFICATION

TRACE	0 -10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

PERCENT BY WEIGHT

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

PARE BORING LOG - GINT STD US LAB.GDT - 3/28/23 16:05 - Y:\JOBS\21 JOBS\21123.01 NOREADING-FIRE STATION RENO DESIGN PH-MA\DATA\BORING LOGS\21123.01 BORING LOGS.GPJ

Pare Corporation
10 Lincoln Road, Suite 210
Foxboro, MA 02035
508-543-1755

BORING NUMBER B23-2

CLIENT HKT Architects
PROJECT NAME North Reading Fire Station Renovation Design
PROJECT NUMBER 21123.01
PROJECT LOCATION North Reading, MA
DATE STARTED 3/16/23 **COMPLETED** 3/16/23
GROUND ELEVATION 64.455 ft NAVD88 **HOLE SIZE** 4 in.
DRILLING CONTRACTOR New England Boring Contractors, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Wash and Drive with GT8 Versa Drill
AT TIME OF DRILLING 2.00 ft / Elev 62.46 ft
LOGGED BY SF **CHECKED BY** BCN
AT END OF DRILLING ---
BORING LOCATION Back of the Fire Station **N:** 3034393 **E:** 769871.1

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
0	64.5		S-1	14 / 24	0 - 2	9-9-7-9 (16)			Moist, medium dense, brown, fine to medium SAND, little fine to medium gravel, trace silt/clay, trace brick.	3" ASPHALT / FILL
			S-2	20 / 24	2 - 4	7-8-7-9 (15)			Wet, medium dense, brown, mostly fine SAND, little silt/clay.	
5	59.5		S-3	16 / 24	4 - 6	6-9-10-10 (19)			Wet, medium dense, light brown, fine to medium SAND, some silt/clay.	
			S-4	20 / 24	6 - 8	6-8-10-10 (18)			Wet, medium dense, light brown, fine to medium SAND, little silt/clay.	
10	54.5		S-5	14 / 24	8 - 10	3-3-6-6 (9)			Wet, loose, light brown, fine to medium SAND, trace silt/clay.	
			S-6	18 / 24	10 - 12	5-6-5-5 (11)			Wet, medium dense, light brown, fine to medium SAND, little silt/clay.	
			S-7	12 / 24	12 - 14	2-3-4-5 (7)			Wet, loose, light brown, fine to medium SAND, trace silt/clay.	
15	49.5		S-8	20 / 24	14 - 16	6-4-7-6 (11)			Wet, medium dense, light brown, fine to medium SAND, trace silt/clay, trace fine to medium gravel.	FINE GLACIAL DEPOSITS
20	44.5		S-9	16 / 24	19 - 21	7-7-12-12 (19)			Wet, medium dense, gray SILT/CLAY.	
25	39.5		S-10	19 / 24	24 - 26	11-7-7-10 (14)			Wet, medium dense, gray SILT/CLAY.	
30	34.5		S-11	13 / 24	29 - 31	17-27-18-29 (45)			Wet, dense, gray, fine to medium SAND, some fine to medium gravel, some silt/clay.	
35									Bottom of borehole at 31.0 feet.	

GRANULAR SOILS

BLOWS/FT	DENSITY
0 - 4	V. LOOSE
4 -10	LOOSE
10 - 30	M. DENSE
30 - 50	DENSE
>50	V. DENSE

COHESIVE SOILS

BLOWS/FT	CONSIST.
<2	V. SOFT
2 - 4	SOFT
4 - 8	M. STIFF
8 - 15	STIFF
15 - 30	V. STIFF
>30	HARD

REMARKS:
1.Rollerbit through top 3" of asphalt.

BURMISTER CLASSIFICATION

TRACE	0 -10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

PERCENT BY WEIGHT

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

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Pare Corporation
10 Lincoln Road, Suite 210
Foxboro, MA 02035
508-543-1755

BORING NUMBER B23-3

CLIENT HKT Architects
PROJECT NAME North Reading Fire Station Renovation Design
PROJECT NUMBER 21123.01
PROJECT LOCATION North Reading, MA
DATE STARTED 3/16/23 **COMPLETED** 3/16/23
GROUND ELEVATION 64.514 ft NAVD88 **HOLE SIZE** 4 in.
DRILLING CONTRACTOR New England Boring Contractors, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Wash and Drive with GT8 Versa Drill
AT TIME OF DRILLING 4.00 ft / Elev 60.51 ft
LOGGED BY SF **CHECKED BY** BCN
AT END OF DRILLING ---
BORING LOCATION Back of the Fire Station **N:** 3034390 **E:** 769919.1

DEPTH (ft)	ELEVATION (ft)	CASING (bl/ft)	SAMPLE TYPE NUMBER	RECOVERY/PEN. (in/in)	DEPTH (ft)	BLOW COUNTS/6"	MIN/FT	GRAPHIC LOG	SAMPLE DESCRIPTION	STRATUM DESCRIPTION
0	64.5									
			S-1	10 / 24	0 - 2	10-16-11-6 (27)			Moist, medium dense, brown, fine to medium SAND, some fine to medium gravel, trace silt/clay.	3" ASPHALT
			S-2	14 / 24	2 - 4	3-5-5-5 (10)			Moist, loose, light brown, fine to medium SAND, some fine to coarse gravel, trace silt/clay.	FILL
5	59.5		S-3	10 / 24	4 - 6	6-3-4-4 (7)			Wet, loose, light brown, fine to medium SAND, trace silt/clay.	
			S-4	14 / 24	6 - 8	5-4-4-6 (8)			Wet, loose, light brown, mostly fine SAND, trace silt/clay.	
10	54.5		S-5	12 / 24	8 - 10	3-3-5-5 (8)			Wet, loose, light brown, fine to medium SAND, trace silt/clay.	
			S-6	21 / 24	10 - 12	4-7-7-12 (14)			Wet, medium dense, light brown, fine to medium SAND, trace silt/clay.	
			S-7	10 / 24	12 - 14	3-5-5-6 (10)			Wet, loose, light brown, fine to medium SAND, trace silt/clay.	
15	49.5		S-8	12 / 24	14 - 16	5-5-9-22 (14)			Wet, medium dense, light brown, fine to medium SAND, trace silt/clay.	FINE GLACIAL DEPOSITS
20	44.5		S-9	18 / 24	19 - 21	7-5-7-6 (12)			Wet, medium dense, gray CLAY/SILT.	
25	39.5		S-10	4 / 24	24 - 26	10-7-11-12 (18)			Wet, medium dense, gray, fine to medium SAND and clay/silt.	
30	34.5		S-11	16 / 24	29 - 31	17-14-19-21 (33)			Wet, dense, fine to medium SAND, some fine to coarse gravel, some clay/silt.	
35									Bottom of borehole at 31.0 feet.	

GRANULAR SOILS

BLOWS/FT	DENSITY
0 - 4	V. LOOSE
4 -10	LOOSE
10 - 30	M. DENSE
30 - 50	DENSE
>50	V. DENSE

COHESIVE SOILS

BLOWS/FT	CONSIST.
<2	V. SOFT
2 - 4	SOFT
4 - 8	M. STIFF
8 - 15	STIFF
15 - 30	V. STIFF
>30	HARD

REMARKS:
1.Rollerbit through top 3" of asphalt.

BURMISTER CLASSIFICATION

TRACE	0 -10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

PERCENT BY WEIGHT

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

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Appendix B:
Laboratory Testing Data

PARE CORPORATION

SIEVE ANALYSIS

SOIL SAMPLE

Location:	Back of Fire Station		
Boring No.:	B-2		
Depth:	29-31		
Sample No.:	S-11		
Specific Gravity, Gs:	NA		

WATER CONTENT

Container No.	II	File No.	21123.01
Wt. Container (g)	191.3	Test No.	2
Wt. Container, Wet Soil (g)	555.8	Date	3/28/2023
Wt. Container, Dry Soil (g)	518.4	Tested By:	SF
Wt. Water (g)	37.4	Checked By	
Wt. Dry Soil (g)	327.1		
Water Content (%)	11.43%	Dry Sieve	NA
Wt. Con, Soil Before Wash (g)	518.4		
Wt. Con, Washed Dry Soil (g)	478.1	Wash Sieve	NA
Wt. Washed Dry Soil (g)	286.8	Combined	X

TOTAL SAMPLE

U.S. Standard Sieve No.	Sieve Opening (mm)	Sieve Wt. (g)	Sieve + Soil Wt. (g)	Wt. of Soil Retained (g)	Accumulative Wt. of Soil Retained (g)	Accumulative Percent Retained	Total Sample Percent Finer By Wt.
2"	50.8				0.0	0.0	100.0
1"	25	0.0	0.0	0.0	0.0	0.0	100.0
0.75"	19.1	0.0	0.0	0.0	0.0	0.0	100.0
0.375"	9.5	0.0	41.1	41.1	41.1	12.6	87.4
4	4.76	0	25.6	25.6	66.7	20.5	79.5
10	2	0.0	18.3	18.3	85.0	26.2	73.8
20	0.85	0.0	22.4	22.4	107.4	33.0	67.0
40	0.425	0.0	40.4	40.4	147.8	45.5	54.5
60	0.250	0	36.5	36.5	184.3	56.7	43.3
100	0.149	0.0	33.8	33.8	218.1	67.1	32.9
200	0.074	0	40.0	40.0	258.1	79.4	20.6
Pan		0	26.6	26.6	284.7	100.0	0.0
Split Sample Wt (Washed)				284.7			
Total Sample Weight				325.0			

Silt During Wash: 40.3 12%

Loss Check: 0.732%

Appendix C:
Geotechnical Limitations

PARE CORPORATION

GEOTECHNICAL LIMITATIONS

Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, Pare Corporation (Pare) should be asked to reevaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in the subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes and or test pits at the times and under the conditions stated on the boring logs and/or test pit logs. This data has been reviewed and interpretations have been made in the text of this report. However, fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time the measurements were made.

Review

4. In the event that any changes in the nature or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are verified in writing by Pare. Pare should also be provided with the opportunity for a general review of the final design and specifications in order that the earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Construction

5. Pare should be retained to provide soil engineering services during construction of the excavation and foundation phases of work in order to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those indicated prior to the start of construction.

Use of Report

6. This report has been prepared for the exclusive use of HKT Architects and the Town of North Reading, MA. for specific application to the proposed building additions to the North Reading Fire Station in North Reading, MA in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.

7. This engineering report has been prepared for this project by Pare. This report is for design purposes only and is not necessarily sufficient to prepare an accurate bid. Contractors wishing a copy of this report may secure it with the understanding that its scope is limited to design considerations only.

Building
Envelope
Consulting, Inc.

REPORT ON WATER TESTING AT
NORTH READING PUBLIC SAFETY BUILDING
152 PARK STREET
NORTH READING, MA 01864

HKT Architects, Inc.
24 Roland Street, Suite 301
Charlestown, MA 02129

June 7, 2022

Attn: Mr. William Hammer, AIA

Dear Bill,

Thank you for considering Building Envelope Consulting, Inc. for services at the above-referenced property. We have completed a program of water testing and herewith submit our report.

The water testing consisted of exposing various building components to water from a hand-held sprayer and a spray rack attached to a garden hose to try to recreate the leakage while interior areas were monitored for leakage. A qualified contractor, B&M Restoration performed some limited exploratory demolition to inspect latent conditions. All areas where exploratory demolition took place were returned to their previous condition.

Typical observations made were recorded by photographs and are included in Appendix A.

Definitions

The following are technical definitions for various building envelope elements referenced to in the following report:

Clear Masonry Sealer: A water repellant applied over clean masonry surfaces to minimize the water absorption of masonry products that can be applied either with a sprayer or roller. Sealers penetrate masonry and do not bridge cracks.

Corrosion: The electro-chemical process where chloride and water interact with and degrade steel reinforcing and structural steel. Corrosion will eventually cause structural steel members (steel *lintels* for example) to fail. Corrosion at reinforcing steel will eventually cause the adjacent brick or terra cotta to *spall.*

Counter-flashing: A material, most often metal, that covers the top of roof membranes where the membrane extends vertically from the roof surface to prevent water from infiltrating.

Efflorescence: White powdery stains that form on mortar, concrete, brick and stone, typically caused by moisture leaching out salts from the material within the masonry.

End Dam: A barrier (usually made with a waterproofing membrane or metal flashing) constructed at the ends of lintels, relieving angles and through-wall flashing to contain the flow of water and prevent leakage.

EPDM (Ethylene Propylene Diene Monomer): A single ply high-performance synthetic rubber polymer used in fully-adhered, ballasted and mechanically-fastened low-slope roof systems.

Flashing: A waterproof material (typically metal or a flexible membrane) used to prevent water infiltration and control drainage.

Masonry Cracks: Cracking of brick, CMU and concrete is the result of freeze-thaw cycles, shrinkage, temperature changes, settlement, loads, rotation and other forms of internal stress. Cracks may affect the long-term structural durability of these materials.

Masonry Step Cracks: Cracks that follow the direction of mortar joints-indicative of water infiltration migrating through the wythe.

Spall: Spall occurs when pieces or layers of masonry or concrete break off from the surface by rusted reinforcing bar or by long-term exposure to the elements. The resulting voids expose the steel reinforcing (if any is present) to the weather, leading to further corrosion of the steel and more spalling of the surrounding surface.

Through-wall Flashing: Flashing that extends from a back-up wall through the exterior veneer surface and bridges the air space between the two. It is used to prevent water infiltration and control drainage.

Traffic Coating: Polyurethane, epoxy or elastomeric waterproof coatings formulated for and applied to streets, highways, parking decks and other surfaces subject to vehicular or pedestrian traffic.

Tuck Pointing: The procedure used to repair deteriorated mortar joints. The deteriorated mortar joints are cut out and filled with new mortar.

Weep Holes: Openings in masonry joints left at the base of a wall or at through-wall flashing so moisture can escape.

Wythe: A continuous vertical section of masonry one unit in thickness. A single wythe is also referred to as a veneer. A multi-wythe wall may be composed of one type of masonry interlocked to increase its mass and structural stability or different types of masonry chosen by function (i.e. less expensive materials on the inner withes coupled with a more aesthetic material on the outer (visible) wythe.

INSPECTION AND TESTING

It was reported that water infiltration has been reported at the following locations:

- In the apparatus bay above firefighters' lockers.
- In the basement at several locations below the apparatus bay overhead doors and the police department evidence room.

The area directly above the firefighters' lockers is a low-slope EPDM roof with a brick masonry wall. The EPDM was observed to be in good condition. The membrane transitions up at the brick wall and terminates approximately twelve inches above the horizontal surface. The termination exceeds the minimum requirement for proper termination by manufacturer's standards by four inches. A metal counter-flashing is located at the top of the termination. The counter-flashing is sealed with a heavy bead of joint sealant (otherwise referred to as "caulking"). Weep holes were not observed. The brick masonry was observed to be in fair condition particularly at the chimney where masonry step cracks and deteriorated mortar were visible. Some of the deteriorated mortar was sealed with caulking.

The water test consisted of exposing the vertical brick masonry to water from a spray rack. It took less than twelve minutes for water to be observed dripping above the lockers.

The apparatus bay concrete floor was replaced around 1997-98. According to drawings prepared by Stahl Associates Architects, the floor was cut approximately twelve inches from the perimeter in order to install new steel columns, beams, joists and metal decking to support a new concrete floor. A steel angle rests on the foundation across the front of the building extending from the apparatus bay into the police evidence room. The steel angle was observed to be in poor condition. Heavy rust and corrosion were evident on the angle and the metal decking. There also were significant water stains and efflorescence on the concrete. A large hole was observed in the foundation at the end of one of the new steel beams closest to the Fire Department offices. Soil from the exterior was clearly visible.

The epoxy-based waterproof coating that covers the apparatus bay concrete floor slab is terminated at the track of overhead doors. The concrete extends out another thirteen to eighteen inches. Another concrete apron extends beyond that approximately twenty inches. The apron is separated from the slab by an open joint. Cracks were visible in the apron as well as the uncovered part of the slab.

The first water test consisted of putting a light spray from a garden hose over the slab and apron at the overhead door closest to the fire department offices. Water was observed dripping in the basement in less than eight minutes.

The second water test consisted of putting a light spray from a garden hose over the slab and apron at the center overhead door. Again, water was observed dripping in the basement in less than eight minutes.

EXPLORATORY DEMOLITION

Minimal exploratory demolition was performed to identify latent conditions. Brick was removed along the low-slope roof above the lockers. The brick was determined to be a single-wythe veneer covering a concrete masonry block wall. The space between the brick and block was measured at 1". The metal flashing had a back leg measuring 4". However, there was a gap between the back leg and the concrete block measuring 1" and no seal or connection was observed.

Minimal exploratory demolition was performed at the apron in front of the apparatus bay. At the right end of the bays (looking from the street) a large hole was uncovered in the foundation during excavation. It appears that the hole was created when the apparatus bay concrete floor was replaced and additional structural steel installed in 1997-98 to allow for new steel beams to be retro-fitted, but the hole was never repaired. The contractor doing the exploratory work formed and poured hydraulic cement to patch the hole.

CONCLUSIONS AND RECOMMENDATIONS

The testing indicates that the leaks above the lockers in the apparatus bay are the result of poor detailing of the through-wall flashing on the low-slope roof. The primary problem is the pan does not extend to the back-up wall nor is it sealed. This provides a clear path for water to seep beyond the pan as it saturates the brick veneer. The secondary problem is the excessive sealant applied over the leading edge of the pan. Through-wall flashing requires weep holes to purge water from the cavity so the sealant traps it.

The solution is to replace the through-wall flashing across the full length of the wall above the lockers. First, remove a minimum of three courses of brick (approximately 9"-10" high) and also remove the existing flashing. Clean the top of the brick and the concrete block back-up wall and set a new flashing pan into a bed of sealant. The back leg of the flashing pan should be a minimum of 2" high and be securely fastened to the concrete block with Tapcon screws or wedge anchors. Prime the remaining exposed concrete block and the flashing pan, then install self-adhered through-wall flashing membrane (Grace, Tremco or equal) over the back leg and extend up the concrete block wall a minimum of 8". Install a metal termination bar across the length of the top of the flashing and seal with mastic. Install new brick veneer with full head joint quadro-vent weeps a minimum of every three bricks (approximately 24").

The testing indicates that the leaks into the basement are the result of multiple factors. Clearly, the hole in the foundation was a significant source. The repair the contractor performed with hydraulic cement should address this area. The remaining leaks across the front of the apparatus bay are due to water seeping through the open joint between the concrete floor slab and concrete apron as well as through cracks in the apron.

The solution is twofold. First, fill the open joint with backer rod and sealant to address those leaks. Next, the cracks in the apron should be routed and sealed and the epoxy traffic coating on the concrete floor should be applied over the concrete apron.

It should be noted that the testing work performed was limited in nature and scope and cannot conclusively duplicate the weather conditions that caused the leakage that prompted this study. The mitigation of leakage should be considered a process of elimination and it is important to be mindful that leakage can occur from multiple sources.

This report is based upon a limited review of the visible and apparent condition of various accessible building elements on the date(s) of this study. Although care has been taken in the performance of the

study, no representation regarding latent or concealed defects, which may exist, and no warranty or guarantee is expressed or implied. The report is made only in the best exercise of our ability and judgment and not intended to be contracting document.

Conclusions in this report are based on normal working life of various building components. Predictions of life expectancy and the balance of useful life are necessarily based on industry and/or statistical comparisons. Actual conditions can alter the useful life of any item and make it impossible to state precisely when each item will require replacement and/or repair.

APPENDIX A
Representative Photographs

Photo 1: Leak area above lockers

Photo 2: Area above lockers where EPDM transitions

Photo 3: Water test above lockers

Photo 4: Leak above lockers during testing

Photo 5: Flashing pan at brick wall

Photo 6: Space behind back leg of flashing pan

Photo 7: Concrete apron in front of apparatus bay doors

Photo 8: Concrete apron in front of apparatus bay doors

Photo 9: Rusted steel angle below apron

Photo 10: Hole in foundation below apron

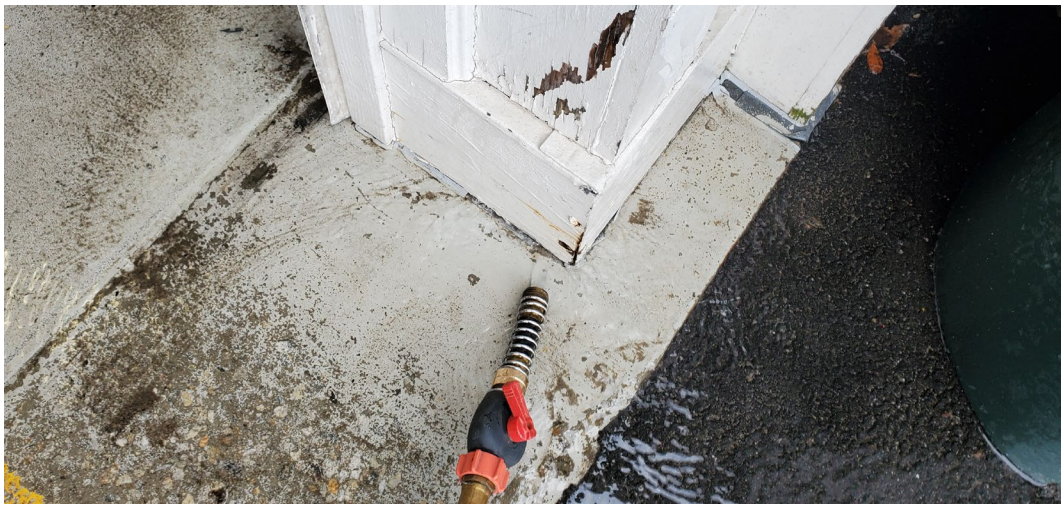

Photo 11: Water test at first overhead door near hole in foundation

Photo 12: Leak in basement below first overhead door

Photo 13: Water test at middle overhead door

Photo 14: Leak in basement below middle overhead door

Photo 15: Hole in foundation ready to be patched

Photo 16: Hole in foundation patched