PROJECT MANUAL

NEWTON EARLY CHILDHOOD PROGRAM

NEWTON, MA

Bid Set – July 22, 2021

ARCHITECT
Arrowstreet Architects PC
10 Post Office Square
Boston, Massachusetts 02109
617-623-5555
www.arrowstreet.com

DOCUMENT 000105

LIST OF CONSULTANTS

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LANDSCAPE
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7 CENTRAL STREET, STE. 15
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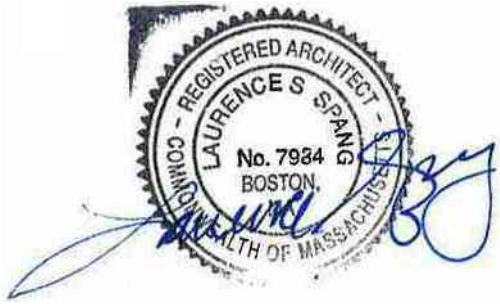
END OF DOCUMENT

DOCUMENT 000107

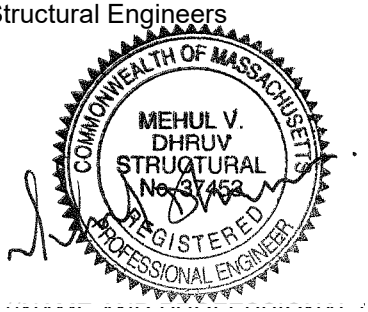
PROFESSIONAL SEALS

SPECIFICATIONS FOR
NEWTON EARLY CHILDHOOD PROGRAM
NEWTON, MA

Designer
Architects
((INSERT DESIGNER'S NAME AND PROFESSIONAL STAMP))



((NAME AND PROFESSIONAL STAMP))
Structural Engineers



NITSCH ENGINEERING, INC.

Civil Engineers

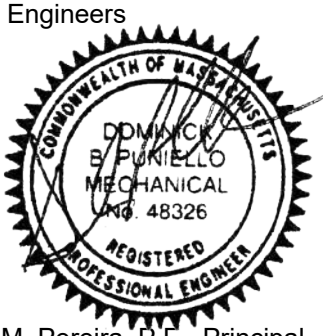
NITSCH PROJECT #13033.3

July 21, 2021

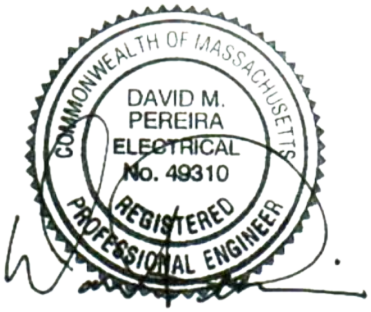
((NAME AND PROFESSIONAL STAMP))
Landscape Architects

((NAME AND PROFESSIONAL STAMP))
Fire Protection Engineers

Dominick B. Puniello, P.E., Principal
HVAC Engineers



David M. Pereira, P.E., Principal
Electrical Engineers



((NAME AND PROFESSIONAL STAMP))
Plumbing Engineers

END OF DOCUMENT

PROJECT MANUAL

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SECTION 011100

SUMMARY OF WORK

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the IFB 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.
10. Miscellaneous Provisions

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:
Newton Early Childhood Program

B. Project Location:
Newton, MA

C. Owner:

City of Newton

D. Owner Project Manager:
Hill International

E. Architect:
Arrowstreet, Inc.

F. Description of the Work

Renovations, improvements, and additions to an existing school building. The project involves the implementation of site improvements and building construction.

1.4 CONTRACT METHOD:

A. A.Project will be constructed under a single prime contract. This Contract shall be a General Contract for Construction, bid as required by Public Bid Laws.

1.5 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.

1.6 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

B. Preceding Work: Owner will award separate contract for the following construction operations at Project site.

1. None.

C. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

1. None.

1.7 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. 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.

C. 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.

1.8 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. Owner-Furnished Products to be Installed by the Contractor:

1. None.

C. 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.

1.9 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 City of Newton Inspectional Services Department. Such Permit shall be displayed in a conspicuous location at the project site.

1.10 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.

1.11 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.

1.12 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 damag-

ing 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 IFB 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. Cleaning materials
6. Safety and disposal requirements.
7. Conduct of the Work.
8. Hours of work.
9. Contractor use of premises.
10. Existing Utilities.
11. Noise control.
12. Safety and disposal requirements and accident prevention.
13. Welding and cutting.
14. Municipal police services
15. Storage of materials off-site
16. Dust control.
17. Cleaning during construction.
18. Debris control and removal of rubbish.
19. Pollution control.
20. 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.

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.

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.

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 comply with General Conditions and Newton ordinances, unless otherwise approved by the Owner with 48 hours advance notice.

B. The Contractor shall comply with applicable local ordinances, including noise 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 allowed only within Limit of Work area located where shown on Drawings. 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 018120 – 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. Copies of material invoices are required to substantiate the cost.
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 OWNER'S OCCUPANCY REQUIREMENTS

A. 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 occupan-

cy, 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.

B. 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.

C. 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

Date: [Date documents are transmitted]

Project: Newton Early Childhood Program

RE: Project Electronic Files

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

The undersigned agrees to accept from Arrowstreet, Inc. the electronic files for the referenced project, 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 Arrowstreet, Inc. for each instance.

The undersigned further agrees to release, indemnify, hold harmless and defend Arrowstreet, 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,
Arrowstreet, Inc.

Accepted and Agreed to:

_____

(General Contractor)

By: _____

Title: _____

SECTION 012200

UNIT PRICES

PART 1 GENERAL

1.01 SUMMARY

A. This Section covers those items for which indefinite quantities can be expected and, therefore, pre-agreed prices per unit of work are established as means to determine adjustments to the Contract Price after actual quantities are determined.

1.02 RELATED REQUIREMENTS

A. Refer to Section 11.3 of the City – Contractor Agreement and requirements of the GENERAL CONDITIONS.

B. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 022820 ASBESTOS REMEDIATION
2. Section 034100 CONCRETE REPAIRS
3. Section 040001 MASONRY WORK and 042000 UNIT MASONRY (Part of 040001 FSB)
4. Section 070002 ROOFING AND FLASHING, 075400 THERMOPLASTIC MEMBRANE ROOFING (part of 070002 FSB), 076200 SHEET METAL FLASHING AND TRIM (part of 070002 FSB), and 077100 ROOF SPECIALTIES (part of 070002 FSB)
5. Section 090005 RESILIENT FLOORS and 096510 RESLIENT FLOORING AND ACCESSORIES (part of 090005 FSB)
6. Section 096800 CARPETING
7. Section 312300, EXCAVATION AND FILL FOR UTILITIES AND PAVEMENT
8. Section 321216 ASPHALT PAVING

1.03 ADDITIONAL REQUIREMENTS

A. Should additional items of work to those listed herein occur, with a need for adjustments to the contract price, the supplemental unit prices for such categories of work shall be as published in the current issue on the date of contract award of Means Cost Data published by R.S. Means Co., Inc.

1. The Owner may choose not to approve any or all unit prices prior to Award of the Contract if it deems the Unit Price unreasonable. In this case, the change order process described in Article 12 of the General Conditions, and other Sections, will be used for Work described in the Unit Price Schedule, when any change of the base contract scope is required.

B. Stated unit prices shall cover all costs, and the prices given shall represent the exact amount per unit to be paid the Contractor (in the case of additions or increases) or to be refunded the Owner (in the case of decreases). No additional adjustment will be allowed for overhead, profit, insurance, compensation insurance or other direct or indirect expenses of Contractor or Subcontractors. Except as otherwise provided in the Contract, there shall be no adjustment for inflation or other indirect cause in unit prices.

C. No allowance will be made for any increased expenses, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly or indirectly from the adjustment of work scope throughout the use of unit prices, or from elimination or

complete omission of items, or from unbalanced allocation among the contract items of overhead expense on the part of the Contractor and subsequent loss of reimbursement therefore, or from any other cause.

D. Prior to commencing removal of materials or placement of materials or other work set forth in the schedule of unit prices as unit price items, the Contractor shall notify the Architect and the Owner's Project Manager in sufficient time to permit proper measurements to be taken on behalf of the Owner. Only quantities which have been approved in writing by the Architect will be considered in the determination of adjustment to the Contract Sum on the unit price basis.

E. Performance of work which is not required under the Contract Documents or which is not authorized by change order or other directive of the Architect, whether or not such work items are set forth hereunder as a unit price item, shall not be considered cause for any extra payment on account of the Contract. The Contractor will be held fully responsible for such unauthorized work, including the performance of all corrective measures required.

F. General bidders and each sub-bidder shall provide only one number in the Bid Forms. The same number will be used for additive unit prices and deductive unit prices.

G. All work associated with Unit Prices work shall conform to the requirements of the individual Specification Sections.

1.04 QUANTITIES AND COST ADJUSTMENTS

A. Quantities:

1. Prior to the start of work involved with each unit price cost item, Contractor shall provide an estimate of the anticipated quantities for review with the Owner and Architect.

2. As the work proceeds on each unit price cost item, the Contractor shall keep a daily accounting of the quantities involved and costs expended. Contractor shall document quantities and inform the Owner and the Architect of total expended work on a weekly basis.

3. As soon as the work involved in each unit cost item has been completed, submit documentation to establish the actual quantities provided. Submit to the Owner and Architect for review and issuance of Change Order.

B. Change Order amount for each unit cost item will be based on actual quantities multiplied by the unit cost. This unit cost includes all mark-ups applicable taxes, overhead, and profit as described below.

1.05 METHOD OF MEASUREMENT OF EARTH EXCAVATION

A. Where earth or gravel fill under the finished paving is required, the excavation will be computed to the bottom of the base preparation course required for the paving in that area.

B. No payment will be made for the excavation of well or coupling holes.

C. Excavation outside the specified lines, whether due to slides or other causes, or made for any reason, will not be paid for. Any material sliding into the excavation shall be removed by the Contractor at his own expense.

D. Basis of Payment: The unit prices per cubic yard for excavation shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, except shoring and bracing required by state and local codes.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

A. Contractor shall complete, sign and attach Document 0122001: BID ATTACHMENT – UNIT PRICE SCHEDULE to submitted bid forms. The Owner may reject any bid received that does not include a completed and signed Document 0122001 listing unit prices.

END OF SECTION

SECTION 012300

ALTERNATES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the IFB 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. For each of the alternates Scheduled at the end of this Section, state the amount in the proposal to be added to or deducted from the Contract Sum for the work.

1.3 ALTERNATES

A. Definition: "Alternates" are alternate products, materials, equipment, systems, methods, units of work or major elements of the construction, which may, at the Owner's option and under the terms established by the Contract or Agreement, be selected for the work in lieu of the corresponding requirements of the Contract Documents. Selection may occur prior to the Contract Date, or may, by the Agreement, be deferred for possible selection at a subsequent date.

B. Alternate Requirements: A Schedule of Alternates is included at the end of this Section. Each alternate is defined using abbreviated language, recognizing that the Contract Documents define the requirements. Coordinate related work to ensure that work affected by each alternate is complete and properly interfaced with work of each selected alternate.

C. Provide written proposals for each alternate on the Bid Form for Owner's consideration. Each proposal amount shall include the entire cost of the alternate portion of the work including overhead, profit, and other costs including cost of interfacing and coordinating the alternate with related and adjacent work.

D. Selection of Alternates: Selection of alternates to be included in the work will be by the Owner.

E. Notification: Immediately following award of Contract, prepare and distribute to each entity a notification of status of each alternate. Indicate which alternates have been accepted, rejected, or deferred for consideration at a later date. Include full description of negotiated modifications to alternates, if any

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate 1- All new VCT

1. Remove existing VCT and carpet fully in all areas of the building that are being partially renovated.
2. Prep and install new VCT in all rooms.

END OF SECTION

SECTION 012400

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the IFB 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 requisi-

tions 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.
5. Maximum line item value NTE $25,000 unless approved by Owner.

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 Sec-

tion 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.
6. Maximum line item value NTE $25,000 unless approved by Owner

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 IFB 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 com-

plete, 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 bench marks. 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 IFB 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 only if 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.

2.2 PROJECT MEETINGS

A. General: Conduct weekly Owner’s progress meetings.

B. 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.

C. The OPM shall take minutes of such meetings and shall distribute copies of the minutes to all concerned.

D. 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.

E. 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 IFB 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 com-

plete 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. Provide 2-week look-ahead schedule at each weekly meeting. 2-week look-ahead shall be tied to Construction schedule.

E. Large format schedule for wall shall be kept on site. Reprint update periodically as agreed to.

F. 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)

G. 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.

H. 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 IFB INSTRUCTIONS TO BIDDERS, for provisions for, and amounts of, Liquidated Damages.

1.5 PHASING

A. The project shall be phased in accordance with the phasing plans as described on the architectural drawings and in Document 002113 – IFB, INSTRUCTIONS TO BIDDERS and Section 011100 – SUMMARY OF WORK.

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

1.7 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 fol-

lowing 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 01 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.
9. Include resource / manpower loading in schedule.

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 work days 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 se-

quence 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 excavation], 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 additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

F. Periodic Construction Photographs: Take [10] photographs [monthly, coinciding] 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 10 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 IFB 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.

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: NEWTON EARLY CHILDHOOD PROGRAM

To: ARROWSTREET

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.

Refer to IFB for additional substitution requirements.

Submitted By:_____
(signature)

Title: _____

Firm:_____

END OF FORM

SECTION 01 35 43

ENVIRONMENTAL 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.

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.

1.2 RELATED WORK UNDER OTHER SECTIONS

A. Section 02 28 20 - Asbestos Remediation.

1.3 HAZARDOUS MATERIALS PROCEDURE

A. Asbestos:

1. Asbestos Materials Exist On-Site: There are accessible and inaccessible asbestos containing materials (ACM) in the existing building. Not all ACM are scheduled to be removed. ACM affected by the renovation and demolition project are included under this contract. The General Contractor shall formally notify each Sub-Contractor that there are ACM existing in the building. Hidden ACM may only be found during renovation and demolition and demolition. Refer to items 2 and 3 below.
2. Unknown and inaccessible ACM: During demolition, it is possible that previously unknown asbestos materials may be discovered in currently concealed locations.
3. Notification: If the General Contractor or Sub-Contractors discover or encounter any ACM during the performance of the work, the General Contractor shall immediately:
   a. Stop work, notify the Architect and OPM about the presence of suspect ACM and request instructions for proper action, and
   b. Take whatever steps and measures are necessary to reduce, control or eliminate the risk of exposure of workers and the public to the ACM.
   c. Every effort will be made to obtain the 10-day DEP waivers to remove hidden or unforeseen ACM by the asbestos contractor. The General Contractor or Sub-Contractor shall allow sufficient time for the removal of the ACM at no additional charges to the owner for delays and should waivers be denied.
4. Responsible Person On-Site: The General Contractor shall designate one of its senior on-site employees to be in charge of coordination between the HAZ MAT Consultant, Architect, and all Sub-Contractors with respect to hazardous materials issues.
5. Responsibility for Hazardous Material Discovery: It is the sole responsibility of the General Contractor and Sub-Contractors to undertake whatever measures, methods or procedures are necessary, required or otherwise appropriate to safeguard the health and safety of all workers and members of the public with respect to identification and discovery of previously unknown hazardous materials during the work of the Project.
6. Damproofing was found to contain asbestos. The Demolition Contractor shall separate/segregate ACM Coated Walls from non-ACM walls and to perform the removal work at no additional cost to the Owner in accordance with all federal and state regulations. The Demolition Contractor is solely responsible for means and methods and techniques used to

properly remove and dispose of the ACM Coated Walls and shall comply with all federal, state and OSHA regulations. The Demolition Contractor shall include in his bid the disposal of 250 ton of ACM Coated Walls. UEC on-site project monitor will record on a daily basis all quantities removed. The Demolition Contractor will be required to do the same. At the completion of the Demolition project, should quantities of ACM Coated Walls removed be found to be less than 250 ton, the Demolition Contractor will be required to issue a credit to the owner based on $140.00 per ton or will be paid $160.00 per ton should quantities of ACM Coated Walls removed be found to be greater than the listed quantity above. The unit price includes all applicable costs including but not limited to site preparation, demolition, segregation, transportation, and disposal. It is also the Demolition Contractor's responsibility to comply with DEP 310CMR 7.15. Certain interior walls (previously exterior due to additions) might be coated with ACM and shall be properly removed and disposed.

7. Quantities for materials included above in items 7 and 8 are in an addition to the scope required to demolish/dispose of the building per the demolition sections and only to be used for additions and deduction. Credit shall be given to the owner for all quantities listed above multiplying by the credit prices should less ACM be found. The Demolition Contractor shall carry all costs related to demolition and disposal in his bid as non-ACM and all scope and quantities listed above in items 7 and 8. The Demolition Contractor shall own the cost for any loss of salvage values of the columns and beams at no additional cost to the owner should ACM was found.
8. UEC will prepare and submit to the DEP for approval a Non-Traditional Work Plan (NTWP) prior to the anticipated demolition at no additional cost to the Demolition Contractor in accordance with DEP 310CMR 7.15. UEC will be providing on-site air monitoring during demolition per DEP requirements at no additional cost to the Demolition Contractor. Demolition Contractor shall comply with the NTWP. It is the Demolition Contractor's responsibility to provide a schedule to UEC 2 months prior to demolition.
9. Indemnification: To the fullest extent permitted by law, the General Contractor and Sub-Contractors shall indemnify and hold harmless the Owner and the Architect and their agents and employees from and against all claims, damages, losses and expenses including, but not limited to, attorneys' fees arising out of or relating to the performance of the Work, including the discovery or identification of any hazardous materials, provided that any such claim, damage, loss or expense if attributable to bodily injury, sickness, disease or death, or to damage to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom; and is caused in whole or in part by any negligent act or omission of the General Contractor and Sub-Contractors, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

B. Lead:

1. The General Contractor and Sub-Contractors shall be made aware that Lead Based Paint exists on painted surfaces throughout the building including structural columns and beams.
2. All the work of this Contract shall conform to the standard set by all applicable Federal, State and Local laws, regulations, ordinance, and guidelines in such form in which they exist at the time of the work on the Contract and as may be required by subsequent regulations.
3. The General Contractor shall retain the services of a licensed lead contractor to scrape painted surfaces and then make intact in areas where sanding, cutting, connecting, and burning and other related work required during renovation and demolitions.
4. The General Contractor and Sub-Contractors are solely responsible for means and methods, and techniques used for demolition and lead control. The General Contractor shall collect, and control lead contaminated debris and to properly remove and dispose of lead contaminated soil around each building due to demolition activities.
5. The General Contractor shall at his own cost and expense comply with all laws, ordinance, rules, and regulations of Federal, State, Regional and Local authorities during demolition, prepping, sanding, cutting, burning, scraping, painting over, grinding and regarding handling, storing, and disposing of lead and lead contaminated waste material.

6. The General Contractor shall submit to the Architect prior to commencing of work the following:
   a. Written respiratory and notification program
   b. Written lead compliance program in accordance with OSHA regulations including:
      1. Training requirement certifications.
      2. Supervisor qualifications.
      3. Written compliance program specific to this project
      4. Respirators fit test records.
      5. Medical surveillance certificates.
7. The EPA and the DEP require demolition debris with lead to be tested in accordance with the Toxicity Characteristic Leaching Procedure (TCLP) to determine the potential for significant amounts of lead to leach out of the waste. If the results are below the DEP standard (5.0 ppm), the waste may be disposed of in a conventional landfill for demolition debris. If, however, the TCLP results are above the DEP standard, the waste must be disposed of in a DEP approved, hazardous waste landfill. The General Contractor shall at own cost and expense perform all required testing of waste by the TCLP. The General Contractor must submit to the Owner copy of tests performed and all waste shipment records prior to disposing of debris. The Owner reserves the right to have own TCLP samples collected to verify results. All disposal costs shall be at the General Contractor's responsibility.
8. The following references are cited as current applicable publications. This project is subject to compliance with all regulations including but not limited to:
   a. Commonwealth of Massachusetts, Department of Labor and Work Force Development 454 CMR 11.00, Structural Painting Safety Code, as currently amended.
   b. Commonwealth of Massachusetts, Department of Environmental Protection, and Hazardous Materials Regulations at 310 CMR 30.00 as currently amended.
   c. U. S. Department of Labor, Occupational Safety and Health Administration Title 29 CFR 1910.1025 and 29 CFR Part 1926.62.
   d. U. S Department of Environmental Protection, Resources Conservation and Recovery Act.
   e. Commonwealth of Massachusetts, Department of Environmental Protection, 310 CMR 6.0-8.0.
   f. Commonwealth of Massachusetts, Department of Environmental Protection ABC rubble rules.

9. All above regulations are applicable to this project. Where there is a conflict between this section and the applicable regulations, the more stringent requirement shall prevail.

C. Other Hazardous Materials:

1. The General Contractor shall be made aware that other hazardous materials are found inside the building. The General Contractor shall be responsible for quantifying, removal, and proper disposal of all hazardous materials in/out the building, including but not limited to batteries and related electrolytic material, PCB's, mercury and Freon inside air conditioners, switches, exit signs, thermostats, and other items.

D. PCB's:

1. The General Contractor and Sub-Contractors shall be made aware that building materials (Material) other than previously sampled including but not limited to painted surfaces, caulking, glue, coatings, sealant, and other building materials are likely to contain >1 ppm of Polychlorinated Biphenyls PCB's.
2. No testing was performed, and no testing will be permitted to be performed by any party working on this project.
3. All of the work of this Contract shall conform to the standard set by all applicable Federal, State and Local laws, regulations, ordinance, and guidelines.

4. The General Contractor and Sub-Contractors are solely responsible for means and methods, and techniques used for demolition and control.
5. The General Contractor and Sub-Contractors shall at its own cost and expense comply with all laws, ordinance, rules, and regulations of Federal, State, Regional and Local authorities during prepping, sanding, cutting, burning, scraping, painting over, grinding and regarding handling, storing, and disposing of contaminated waste material and during demolition of the building.

E. Silica Dust:

1. The General Contractor and Sub-Contractors shall be made aware that building materials (Material) may contain Silica.
2. Due to the difficulty associated with exhaustive testing, the Owner has elected to direct the General Contractor and Sub-Contractors to assume that Silica was found.
3. The General Contractor and Sub-Contractors shall review and comply with most recent US Department of Labor Final Rule and shall take extra precautions to protect workers and other personnel on site.

PART 2 – PRODUCTS Not Used

PART 3 – EXECUTION Not Used

END OF SECTION

SECTION 014000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the IFB 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 constructed.
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 judg-

ing the completed Work.

7. Demolish and remove mockups when directed, unless otherwise indicated.

K. Classroom Mockup: Provide a fully finished classroom mockup including equipment, lighting, and specialties for review and approval.

L. 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 01 45 23

TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The 9th Edition of the Massachusetts State Building Code, 780 CMR, 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 inspections for this project in accordance with 780 CMR 17.00.The SER is the structural engineer (an individual) 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 Inspections for Compliance with Chapter 17 of IBC 2015, 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 statement of structural tests and inspections shall not relieve the General Contractor or its subcontractors of their responsibilities and obligations for quality control of the Work, their other obligations for supervising the work, for any design work which is included in their scope of services, and for full compliance with the requirements 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 General Contractor or its subcontractors of their responsibility to correct all deficiencies or defects, whether detected or undetected, in all parts of the Work, and to otherwise comply with all requirements of the Contract Documents.

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

1.2 GENERAL CONTRACTOR’S RESPONSIBILITIES

A. Where the document Statement of Special Inspections for Compliance with Chapter 17 of IBC 2015 indicates that a structural component or system is subject to structural tests and inspections by 780 CMR 17.00 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 or system, and the Architect has not otherwise provided for the structural design of said component or system, the General Contractor shall retain, or require others under his aegis 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. This engineer shall visit the site and provide an affidavit to the SER addressed to the Building Inspector verifying that construction has been completed in accordance with the submitted documents.

C. The General 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 General 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.

D. The General Contractor shall give reasonable notice to the SER, or to those performing inspections and tests under the SER's direction, of when the various parts of the Work will be ready for inspection. The General Contractor shall obtain instructions from the SER as to what is reasonable notice for the various aspects of the work, and who is to be notified.

E. The Owner reserves the right to back charge the General Contractor for additional expense incurred by the Owner for the services of the SER or those under his direction when work is not reasonably ready for inspection in accordance with the notice provided by the General Contractor.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the IFB 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.

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 pipe lines 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. One (1) Mobile Phone with National Plan 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 the building will be occupied by children. 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.

1. Provide black scrim on fencing.

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. 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.

F. Post construction site signs, no smoking and directions to office etc.. Post orange diamond construction signs on Watertown both sides and Albemarle indicating construction site.

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.

1. PBD field office will be located in room #121 and will not require phones, furniture or equipment. Exhaustible office supplies will be required along with coffee (Kcups), creamers, plate and napkins.

2. The contractor shall assist in relocating the offices as required for the renovation work.

PART 3 - EXECUTION (NOT USED])

END OF SECTION

SECTION 015639

TEMPORARY TREE AND PLANT PROTECTION

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 SUMMARY

A. Section includes:
   1. General protection of existing vegetation to remain.

B. Related Sections:

   1. Section 311300 “SELECTIVE REMOVAL AND TRIMMING” for removal and pruning of existing trees and shrubs.
   2. Section 312300 “EXCAVATION & FILL FOR UTILITIES AND PAVEMENT” for site preparation.
   3. Section 312500 "EROSION AND SEDIMENTATION CONTROLS" for temporary erosion and sedimentation control measures.

1.3 DEFINITIONS

A. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally 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 (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

E. Caliper: Diameter of a trunk measured by a diameter tape at 4’-6” above the ground or DBH (diameter at breast height). (Standard as defined by the ISA – International Society for Arboriculture).

F. Arborist or Certified Arborist: As referenced here in all “arborists” or “certified arborists” shall be at minimum an ISA Certified Arborist or and ASCA Registered Consulting Arborist unless other specified.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:

1. Organic Mulch: 1-quart (1-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.6 QUALITY ASSURANCE

A. Arborist Qualifications: An experienced arborist certified by ISA, be licensed in the jurisdiction where Project is located, and be a current member of ASCA, or registered Consulting Arborist as designated by ASCA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
b. Enforcing requirements for protection zones.
c. Arborist's responsibilities.
d. Field quality control.

1.7 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.

B. Topsoil: Contractor shall be responsible for managing and tracking all topsoil materials excavated and placed in stockpiles for testing as required by the governing authorities (City and State).

C. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Wood and bark mulch.
2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
3. Color: Natural.

D. Protection-Zone Fencing: Fencing fixed in position and meeting **one of** the following requirements. Previously used materials may be used when approved by Owner's Representative.

1. Wood Protection-Zone Fencing: Constructed of two 2-by-4-inch (50-by-100-mm) horizontal rails, with 4-by-4-inch (100-by-100-mm) preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart, and lower rail set halfway between top rail and ground.

a. Height: 4 feet (1.2 m).

E. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

1. Size and Text: Per Owner's / City's requirements.
2. Lettering: Per Owner's / City's requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. **Tie** a 1-inch (25-mm) blue-vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.

1. Apply 4-inch (100-mm) average thickness of organic mulch. Do not place mulch within 6 inches (150 mm) of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people] from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Owner's Representative.
3. Access Gates: Install as required; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Owner's Representative. Install one sign spaced approximately every 20 feet (6 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner's Representative.

E. Maintain protection-zone fencing and signage in good condition as acceptable to Owner's Representative and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312300 "EXCAVATION & FILL FOR UTILITIES AND PAVEMENT."

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: See Section 311300 "SELECTIVE TREE REMOVAL AND TRIMMING." Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.6 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.7 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner's Representative.

1. Submit details of proposed root cutting and tree and shrub repairs.
2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
4. Perform repairs within 24 hours.
5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Owner's Representative.

B. Trees: Remove and replace trees indicated to remain that are more than **66** percent dead or in an unhealthy condition **before the end of the corrections period** or are damaged during construction operations that Owner's Representative determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches (100 mm) or smaller in caliper size.
2. Provide one new tree of 4-inch (100-mm) caliper size for each tree being replaced that measures more than 6 inches (150 mm) in caliper size.

    a. Species: selected by Owner's Representative.

3. Plant and maintain new trees as specified in Section 329300 "PLANTS."

C. Soil Aeration: Where directed by Owner's Representative, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 017329

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the IFB 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 055000 – METAL FABRICATIONS, for furnishing of lintels where required for all penetrations through new and existing masonry.
6. Section 078410 – PENETRATION FIRESTOPPING, for patching fire-rated construction.
7. Division 9 – FINISHES, for all patching of new and existing construction, except for masonry and concrete.
8. Section 092110 – GYPSUM BOARD, for cutting and patching gypsum wallboard construction.
9. 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.
10. 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.
11. 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 078410 – PENETRATION 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. 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 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 IFB 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.

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 75% 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 require-

ments 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] [Contractor].

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 IFB 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

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 IFB 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. Photographic documentation of construction: Section 013200 – CONSTRUCTION PROGRESS DOCUMENTATION.
3. Availability of electronic files for preparation of record documents: Section 011400 – WORK RESTRICTIONS.
4. Surveying and field engineering: Section 013100 – PROJECT MANAGEMENT AND COORDINATION.
5. General requirements for submittals: Section 013300 – SUBMITTAL PROCEDURES.
6. Other submittals required at the completion of the Work: Section 017700 – CLOSEOUT PROCEDURES.

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. Division 21 – FIRE PROTECTION.
2. Division 22 – PLUMBING.
3. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING.
4. Division 26 – 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.

F. Con Com Requirements: Provide stamped site as-builts with all utilities, ties etc. Profiles of all utilities, Video.

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 videotape-recorded by professional videographers in VHS 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. Tapes 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 tapes shall be properly labeled as to date, subject, and presenter. Provide two (2) copies of each tape.

END OF SECTION

SECTION 018120

CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the IFB 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. Requirements for minimum indoor air quality (IAQ) performance standards during the construction period and before occupancy.
2. With regard to these goals the Contractor shall develop, for Owner and Architect review, a Construction Indoor Air Quality Management Plan for this Project.

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

1. Section 017400 - CONSTRUCTION WASTE MANAGEMENT.
2. Division 23 - HVAC.
3. Divisions 02 through 48 Specification Sections; Specific requirements relating to indoor air quality for each Section.

1.3 PERFORMANCE REQUIREMENTS

A. Prevent exposure of building systems to environmental tobacco smoke during construction. At a minimum, take the following measures:

1. Do not allow smoking in enclosed portions of the project site.
   a. This prohibition includes electronic cigarettes.
2. Locate exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows. Provide signage for designated smoking areas at each entry.

B. During construction meet or exceed the minimum requirements of the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, Second Edition, November 2007, Chapter 3.

C. Protect absorptive materials from moisture damage when stored on-site and after installation.

D. During construction, comply with the following requirements:

1. If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 13 shall be used at each return air grille,

as determined by ASHRAE 52.2-1999. Replace filtration media immediately prior to occupancy.

E. After construction ends but before occupancy, comply with one of the following requirements:

1. Perform a building flush-out with outside air.
2. Conduct IAQ testing for air contaminant levels in the building.

1.4 SUBMITTALS

A. Construction Indoor Air Quality (IAQ) Management Plan: With the completed Form of Bidder's Proposal, the Contractor shall submit a preliminary Construction IAQ Management Plan.

1. Within 21 calendar days after receipt of Notice to Proceed, the Contractor shall submit to the Owner a finalized Construction IAQ Management Plan.
2. The proposed Plan shall comply with Division 23 – HVAC requirements.
3. The proposed Plan shall include, but not be limited to, the following:
    a. Protection of ventilation system components during construction.
    b. Cleaning and replacing contaminated ventilation system components after construction, including filtration media.
    c. Temporary ventilation.
    d. Protection of absorptive materials from moisture damage when stored on-site and after installation, including exterior wall rain protection.
    e. Sequence of finish installation plan.
    f. Selection of cleaning products and procedures to be used during construction and final cleaning.
    g. Other items as required by SMACNA IAQ Guidelines for Occupied Buildings under Construction, Chapter 3.
4. Coordinate Construction IAQ Management Plan with Owner's current IAQ management plans and procedures.

B. Indoor Air Quality (IAQ) Data: Submit emission test data as required, with testing laboratory and date clearly identified.

C. Material Safety Data Sheets (MSDS): Submit for materials as required, with date clearly identified. MSDS must contain specific chemical content data identifying the percent of the total product mass represented by each listed chemical.

D. Product Data: Submit for each type of filtration media used during construction and installed immediately prior to occupancy, with MERV values clearly identified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Take special care to prevent accumulation of moisture on materials and within packaging during delivery, storage, and handling to prevent development of mold and mildew inside packaging and on products.

B. Immediately remove from site and properly dispose of materials showing signs of mold and mildew, including materials with moisture stains.

PART 2 - PRODUCTS

2.1 FILTRATION MEDIA

A. Filtration Media: Comply with ASHRAE 52.2-1999 and provide MERV as required.

PART 3 - EXECUTION

3.1 CONSTRUCTION IAQ MANAGEMENT PLAN IMPLEMENTATION

A. IAQ Manager: The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Construction IAQ Management Plan for the Project.

B. Distribution: The Contractor shall distribute copies of the Construction IAQ Management Plan to the Job Site Foreman, each subcontractor, the Owner, and the Architect.

C. Instruction: The Contractor shall provide on-site instruction of appropriate procedures and methods to be used by all parties at the appropriate stages of the Project.

D. Preconditioning: Allow products, which have odors and significant VOC emissions, to off-gas in a dry, well-ventilated space for sufficient period to dissipate odors and emissions prior to delivery to Project.

1. Remove containers and packaging from materials prior to conditioning to maximize off-gassing of VOCs.
2. Condition products in ventilated warehouse or other building.

E. Coordinate Construction IAQ Management Plan with final cleaning.

END OF SECTION

SECTION 02 28 20

ASBESTOS REMEDIATION

PART I - 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. 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.

1.2 RELATED WORK UNDER OTHER SECTIONS

A. Section 01 35 43 - Environmental Procedures

1.03 DESCRIPTION OF WORK:

A. The work includes the removal and disposal of asbestos containing materials (ACM) as indicated in Part 3 of this Section.

B. The General or Demolition Contractor shall retain the services of a Massachusetts licensed asbestos abatement contractor. The asbestos contractor must include in his scope of work all required services included in Part 3 and must accept unit prices included at the end of this section to be used for addition and deduction.

1.04 POTENTIAL ASBESTOS HAZARD & DEBRIS

A. Where in the performance of the work, workers, supervisory personnel, subcontractors, or consultants may encounter, disturb, or otherwise function in the immediate vicinity of any identified ACM, take appropriate continuous measures as necessary to protect all building occupants from the potential hazard of exposure to airborne asbestos. Such measures shall include the procedures and methods described herein, and compliance with regulations of applicable federal, state, and local agencies.

B. If the Contractor failed to comply with the requirements of the specifications, the Owner's Representative (Asbestos Project Monitor) may present a written stop of work order. The Contractor must immediately and automatically stop all work until authorized in writing by the Asbestos Project Monitor to commence work. All costs related to delays shall be at the Contractor’s expense.

1.05 DEFINITIONS

A. Abatement: Procedures to control fiber release from ACM. Includes encapsulation, enclosure, and removal.

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

C. Area Monitoring: Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area, which is representative of the airborne concentrations of asbestos fibers, which may reach the breathing zone.

D. Asbestos: The name given to a number of naturally occurring hydrated mineral silicates that possess a unique crystalline structure are incombustible and are separable into fibers. Asbestos includes Chrysotile, Crocidolite, Amosite, Anthophyllite, and Actinolite.

E. ACM: Any material containing equal to 1% or greater by weight of asbestos of any type or mixture of types. State laws may vary in their definition of asbestos containing material.

F. Barrier: Any surface that seals off the work area to inhibit the movement of fibers.

G. Critical Barrier: A solid, asbestos impermeable partition erected so as to constitute a work area closure; the outer perimeter of an asbestos work area, usually erected across corridors or other open spaces to complete containment.

H. Designer: Commonwealth of Massachusetts licensed Designer Ammar Dieb, Universal Environmental Consultants (AD-900326).

I. Enclosure: All herein specified procedures necessary to complete enclosure of all ACM behind airtight, impermeable, permanent barriers.

J. Friable Asbestos Material: Material that contains more than one percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

K. HEPA Filter: A High Efficiency Particulate Absolute (HEPA) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 microns in length.

L. Asbestos Project Monitor: An Asbestos Project Monitor certified in the Commonwealth of Massachusetts to perform monitoring.

M. Removal: All herein specified procedures necessary to strip all ACM from the designated areas and to dispose of these materials at an acceptable site.

N. Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

O. Visible Emissions: Any emissions containing particulate asbestos material that are visually detectable without the aid of instruments. This does not include condensed uncombined water vapor.

P. Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as asbestos contaminated waste.

Q. Work Area: Any area indicated on the Drawings as asbestos abatement areas or as areas containing friable asbestos material.

R. Worker Decontamination Enclosure System: A decontamination enclosure system for workers, typically consisting of a clean room, a shower room, and an equipment room.

1.06 STOP WORK

A. Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

B. Keep driveways, parking, and entrances serving premises clear and available to Owner, Owner's employees, traffic, upon Owner occupancy, and emergency vehicles at all times. Do not use these areas for parking or storage of materials, unless authorized in writing by the Owner

C. Smoking or open fires will not be permitted within the building enclosure or on the premises

1.07 CONTRACTOR'S USE OF THE EXISTING BUILDING

A. Keep existing driveways and entrances serving the premises clear and available to the Owner and his employees at all times. Do not use these areas for parking or storage of materials, unless authorized in writing by the Owner.

B. Smoking or open fires will not be permitted within the building enclosure or on the premises.

1.08 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. Provide a full time Site Supervisor for work under this Section with all appropriate state licenses, who is experienced in administration and supervision of asbestos abatement projects including work practices, protective measures for building and personnel and disposal procedures. This person is the Competent Person in accordance with 29 CFR 1926 for the Contractor and is the Contractor's representative responsible for compliance with all applicable federal, state, and local regulations, particularly those relating to ACM. This person shall have completed a course at an EPA Training Center or equivalent certificate course in asbestos abatement procedures, have had a minimum of two years on the job training and meet all additional requirements set forth in 29 CFR 1926 for a Competent Person.

B. The Site Supervisor must be certified by the State of Massachusetts. Asbestos Contractor shall provide proof of such certification to the Asbestos Project Monitor not less than 10 days prior to commencing any work.

1.09 SPECIAL REPORTS

A. Except as otherwise indicated, submit special reports directly to the Asbestos Project Monitor within one day of occurrence requiring special report, with copies to all others affected by the occurrence.

B. When an event of unusual and significant nature occurs at the site (examples: failure of negative pressure system, rupture of temporary enclosures, unauthorized entry into work areas), prepare and submit a special report listing date and time of event, chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. When such events are known or predictable in advance, advise the Asbestos Project Monitor in advance at earliest possible date.

C. Prepare and submit special reports of significant accidents, at the site and anywhere else work is in progress related to this project. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

1.10 CONTINGENCY PLAN

A. Prepare a contingency plan for emergencies including fire, accident, power failure or any other event that may require modification of decontamination or work area isolation procedures. Include in the plan specific procedures for decontamination or work area isolation. A copy of the plan shall be submitted to and approved by the Asbestos Project Monitor prior to any work being done.

B. Post in the clean room of the decontamination unit and in the Contractor's office trailer telephone numbers and locations of emergency services including but not limited to fire, ambulance, doctor, hospital, and police.

1.11 PERMITS AND NOTIFICATIONS

A. Secure necessary permits in conjunction with asbestos removal, hauling, and disposition and provide timely notification as may be required by federal, state, regional, and local authorities. Notify the Department of Environmental Protection (DEP) and the Massachusetts Department of Labor Standards (DLS) and provide copies of the notification to the Designer, Asbestos Project Monitor, and the State Environmental Regulatory Agency 10 working days (Document Submission Date) prior to commencement of the work.

B. No later than the Document Submission Date, notify the local fire, police, and Health Departments, in writing, of proposed asbestos abatement work. Advise the fire department of the nature of the asbestos abatement work, and the necessity that all firefighting personnel who may enter the work site in the case of fire wear self-contained breathing apparatus. Provide one copy of the notices to the Asbestos Project Monitor prior to commencing the work.

C. No later than the Document Submission Date, submit proof satisfactory to the Asbestos Project Monitor that all required permits, site location, and arrangements for transport and disposal of asbestos containing or contaminated materials, supplies, and the like have been obtained.

1.12 SAFETY COMPLIANCE

A. Comply with laws, ordinances, rules, and regulations of federal, state, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials.

B. Comply with the applicable requirements of the current issue of 29CFR 1926.1101 and 40CFR 61, Subparts A and B. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work.

1.13 RESPIRATOR PROGRAM

A. Establish a respirator program by ANSI Z88.2 and 29 CFR 1926.1101 (h), 1926. 103, and 19l0.134.

1.14 PERSONNEL PROTECTION

A. Prior to commencement of work, workers shall be instructed in and shall be knowledgeable of the hazards of asbestos exposure; use and fitting of respirators; use of showers; entry and exit from work areas, and all aspects of work procedures and protective measures.

B. All asbestos abatement workers shall receive training and shall be accredited per 40 CFR 763.90(g). Training and accreditation shall be in accordance with 40 CFR 763, Appendix C to Subpart E. Training shall also be provided to meet the requirements of OSHA Regulations contained in 29 CFR 1926.

C. Prior to the start of work, the Asbestos Contractor shall provide medical examinations for all employees in accordance with 29CFR 1926.1101 (m). All employees hired by the Asbestos Contractor after start of work shall have medical examinations in accordance with this paragraph before being put to work.

D. Maintain complete and accurate records of employee's medical examinations, during employment and make records of the required medical examinations available for inspection and copying to: The Assistant Secretary of OSHA, the Director of The National Institute for Occupation Safety and Health (NIOSH), authorized representatives of either of them, and an employee's physician upon the request of the employee or former employee.

E. Provide personnel exposed to airborne concentrations of asbestos fibers with fire retardant disposable protective whole-body clothing, head coverings, gloves, and foot coverings. Provide gloves to protect hands. Make sleeves secure at the wrists and make foot coverings secure at the ankles by the use of tape. Asbestos Contractor shall require and monitor the use of complete protective clothing. A competent person designated by the Asbestos Contractor in accordance with 29CFR 1926.1101 shall periodically examine protective clothing worn by employees in the work area for rips or tears. When rips or tears are detected, they shall be immediately mended or replaced.

F. Provide goggles to personnel engaged in asbestos operations when the use of a full-face respirator is not required.

G. Provide authorized visitors with suitable protective clothing, headgear, eye protection and footwear, whenever they are required to enter the work area, to a maximum of 3 changes for 3 visitors per day. One of the sets of protective clothing shall be available for full time use by the Asbestos Project Monitor.

H. Provide all persons with personally issued and marked respiratory equipment approved by NIOSH and OSHA. The appropriate respiratory protection shall be selected according to the most recent Massachusetts regulations.

I. Once all visible asbestos material has been removed during decontamination, cartridge type respirators will be allowed during the final cleanup provided the measured airborne concentrations do not exceed 0.1 fibers per cubic centimeter. Where respirators with disposable filters are employed, provide sufficient filters for replacement to the worker or applicable regulation.

J. If the permissible respirators fail to provide sufficient protection against volatiles Organic Compounds, emitted by any sealant used, the services of a qualified Certified Industrial Hygienist will be procured, at the Asbestos Contractor's expense, to determine proper respiratory protection. The Owner and Asbestos Project Monitor will not be liable for the cost of increased respiratory protection.

K. Select respirators from those approved by the Mine Safety and Health Administration (MSHA), Department of Labor, or the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services. All personnel wearing negative pressure respirators shall have respirator fit tests within the last six months and signed statements shall be available.

1.15 REFERENCE STANDARDS

A. Unless otherwise indicated, all referenced standards shall be the latest edition available at the time of bidding. Requirements of this Section shall in no way invalidate the minimum requirements of the referenced standards. Comply with the provisions of the following codes and standards, except as otherwise shown or specified. Where conflict among requirements or with this Section exists, the more stringent requirements shall apply.

B. U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA) requirements, which govern asbestos abatement work or hauling and disposal of asbestos waste materials.

C. U.S. Environmental Protection Agency (EPA) requirements, which govern asbestos abatement work or hauling and disposal of asbestos waste materials.

D. U.S. Department of Environmental Protection (DEP) 310 CMR 7.15 and the Massachusetts Department of Labor Standards (DLS) 454 CMR 28.

1.16 SUBMITTALS

A. No work may commence until submittals have been approved by the Designer. Complete submittals are to be submitted no less 10-working days prior to desired commencement of the work. The submittals shall include the following:

1. Submit all licenses and certification required.
2. Submit written evidence that the landfill to be used for disposal of asbestos is approved for disposal of asbestos by the EPA.
3. Submit all required items previously listed in this section.
4. Secure necessary permits in conjunction with asbestos removal, hauling, and disposition and provide timely notification as may be required by federal, state, regional, and local authorities. Notify the Department of Environmental Protection (DEP) and the Massachusetts Department of Labor Standards (DLS) and provide copies of the notification.
5. Notify the local fire, police, and Health Departments, in writing, of proposed asbestos abatement work. Advise the fire department of the nature of the asbestos abatement work, and the necessity that all firefighting personnel who may enter the work site in the case of fire wear self-contained breathing apparatus. Provide one copy of the notices.
6. Submit proof that all required permits, site location, and arrangements for transport and disposal of asbestos containing or contaminated materials, supplies, and the like have been obtained.
7. The Contractor shall submit a plan for managing the waste including all collection, storage, disposal, and decontamination practices/waste disposal.
8. Submit medical examinations for all employees in accordance with 29CFR 1926.1101 (m). All employees hired by the Asbestos Contractor after start of work shall have medical examinations in accordance with this paragraph before being put to work.
9. Provide MSDS for all used products on this Project.
10. Submit the negative pressure system. Include in the submittal at a minimum:

a. Number of negative air machines required and the calculations necessary to determine the number of machines.
b. Description of projected airflow within the work area and methods required providing adequate airflow in all portions of the work area.
c. Location of machines in the work area.
d. Location of pressure differential measurement equipment.
e. Manufacturers product data on equipment used to monitor pressure differential.

11. Submit the form of security and safety log, which will be maintained on the project.
12. Submit written evidence that the landfill to be used for disposal of asbestos is approved for disposal of asbestos by the Department of Environmental Protection.
13. Submit proof that training requirements as specified in 29CFR 1926.1101 (k) (3) and by appropriate state agencies has been complied with.
14. Submit a description of the plans for construction of decontamination enclosure systems and for isolation of the work areas in compliance with this specification and all applicable regulations.
15. Submit a detailed schedule including work dates, work shift time, number of employees, dates of start and completion of all work activities (including mobilization, work area preparation, asbestos abatement, inspection and clearance monitoring, each phase of refinishing, and final inspections). Schedule shall be updated with each partial payment request.

1.17 REPORTING

A. Maintain on site a daily log documenting the dates and time of the following items, as well as other significant events:

1. Minutes of meetings: purpose, attendees, and brief discussion
2. Visitations: authorized and unauthorized
3. Personnel: by name, entering and leaving the work area
4. Special or unusual events
5. Personnel air monitoring tests and results

B. Documentation with confirmation signature of the Asbestos Project Monitor of the following:

1. Inspection of work area preparation prior to start of removal and daily thereafter.
2. Removal of any polyethylene barriers.
3. Removal of waste materials from work area and transport and disposal at approved site.
4. Decontamination of equipment.
5. Waste Shipment Records. No final payment will be approved until all above documents have been submitted.

C. Provide two bound copies of this log to the Asbestos Project Monitor with the application for final payment.

1.18 AIR MONITORING

A. Throughout the entire removal and cleaning operations, air monitoring will be conducted to ensure that the Asbestos Contractor is complying with the EPA and OSHA regulations and any applicable state and local government regulations. The Owner will provide an Asbestos Project Monitor (Universal Environmental Consultants) to take air samples at the job site at no cost to the Asbestos Contractor.

B. The purpose of the Asbestos Project Monitor's air monitoring will be to detect faults in the work area isolation such as:
   1. Contamination of the building outside of the work area with airborne asbestos fibers,
   2. Failure of filtration or rupture in the negative pressure system,
   3. Contamination of the exterior of the building with airborne asbestos fibers.
   4. Should any of the above occur, the Asbestos Contractor should immediately cease asbestos abatement activities until the fault is corrected. Work shall not recommence until authorized by the Asbestos Project Monitor.

C. The Asbestos Project Monitor will monitor airborne fiber counts in the work area. The purpose of this air monitoring will be to detect airborne fiber counts higher than the Action Level of 0.1- f/cc which may significantly challenge the ability of the work area isolation procedures to protect the balance of the building from contamination by airborne fibers.

D. The Asbestos Contractor shall be responsible for providing his/her own personnel monitoring within the work area in accordance with CFR 1926.1101.

1.19 AIRBORNE FIBER COUNTS

A. If any air sample taken outside of the work area exceeds the base line (background) conducted by the Asbestos Project Monitor, Immediately and automatically stop all work. If this air sample was taken inside the building and outside of critical barriers around the work area, immediately erect new critical barriers to isolate the affected area from the balance of the building.
   1. Respiratory protection shall be worn in affected area.
   2. Leave critical barriers in place until completion of work and ensure that the operation of the negative pressure system in the work area results in a flow of air from the balance of the building into the affected area.
   3. A final inspection after removal of poly shall be completed by the Asbestos Contractor's Supervisor and the Asbestos Project Monitor.

B. The following procedure shall be used to resolve any disputes regarding fiber types when work has been stopped due to excessive airborne fiber counts. "Airborne Fibers" referred to above include all fibers regardless of composition as counted in the NIOSH 7400 Procedure. If work has stopped due to high airborne fiber counts, air samples will be secured in the same area by the Asbestos Project Monitor for analysis by Transmission Electron microscopy (TEM). Airborne Fibers counted in samples analyzed by TEM shall be only asbestos fibers, but of any diameter and length. Subsequent to analysis by TEM the number of "Airborne Fibers" shall be determined by multiplying the number of fibers, regardless of composition, counted by the NIOSH 7400 procedure by a number equal to asbestos fibers counted divided by all fibers counted in the TEM analysis.

C. If TEM is used to arrive at the basis for determining "Airborne Fiber" counts in accordance with the above paragraph, and if the average of airborne asbestos fibers in all samples taken outside the work area exceeds the base line, then the cost of such sampling and analysis will be born by the Asbestos Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Plastic Sheet: 6 mil minimum thickness, unless otherwise specified, in sizes to minimize the frequency of joints.

B. Tape: Capable of sealing joints of adjacent sheets of plastic and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under dry and wet conditions, including use of amended water. Provide tape, which minimizes damage to surface finishes.

C. Cleaning Materials: Use materials recommended by manufacturer of surface to be cleaned. Use cleaning materials only on surfaces recommended by the cleaning material manufacturer.

2.02 EQUIPMENT

A. Supply the required number of asbestos air filtration units to the site in accordance with these specifications.

2.03 DANGER SIGNS AND LABELS

A. Display danger signs at each location where airborne concentrations of asbestos fibers may be in excess of 0.0l fibers/cc. Post signs at such a distance from such a location so that an employee may read the signs and take necessary protective steps before entering the area marked by the signs.

B. The sign shall also contain a pictorial representation of possible danger or hazard, such as a skull and cross bone, or other suitable warning as approved by the Asbestos Project Monitor. Sign shall meet the requirements of 29CFR 1926.200. A sample of the signs to be used shall be submitted to the Asbestos Project Monitor for approval prior to beginning work area preparation.

C. Affix danger labels to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, or to their containers.

2.04 PERSONNEL DECONTAMINATION UNIT

A. Prior to any asbestos abatement work, including placement of plastic on walls that will contact or disturb asbestos containing surfaces, or removal of light fixtures or any items on asbestos containing surfaces, construct a Personnel Decontamination Unit consisting of a serial arrangement of connected rooms or spaces, Changing Room, Shower Room, and Equipment Room. Require all persons without exception to pass through this decontamination unit for entry into and exiting from the work area for any purpose.

B. Build suitable framing or use existing rooms, with the Asbestos Project Monitor written approval, connected with framed in tunnels if necessary; line with 6 mil plastic; seal with tape at all lap joints in the plastic for all enclosures and decontamination enclosure system rooms. Decontamination units and access tunnels constructed outside shall be constructed with tops made of 5/8" plywood or approved equal. In all cases, access between contaminated and uncontaminated rooms or areas shall be through an airlock. In all cases, access between any two rooms within the decontamination enclosure systems shall be through a curtained doorway.

C. Provide a changing (clean) room for the purpose of changing into protective clothing. Construct using polyethylene sheeting, at least 6-mil in thickness, to provide an airtight seal between the Clean Room and the rest of the building. Locate so that access to work area from Clean Room is through Shower Room. Separate Clean Room from the building by a sheet polyethylene flapped doorway.

D. Require workers to remove all street clothes in this room, dress in clean disposable coveralls, and don respiratory protection equipment. Do not allow asbestos contaminated items to enter this room. Require workers to enter this room either from outside the structure dressed in street clothes, or naked from the showers.

E. An existing room may be utilized as the changing room if it is suitably located and of a configuration whereby workmen may enter the Clean Room directly from the Shower Room. Protect all surfaces of room with sheet plastic. Authorization for this shall be obtained from the Asbestos Project Monitor in writing prior to start of construction.

1. Maintain floor of changing room dry and clean at all times. Do not allow overflow water from shower to wet floor in Changing Room.
2. Damp wipe all surfaces twice after each shift change with a disinfectant solution.
3. Provide a continuously adequate supply of disposable bath towels.
4. Provide posted information for all emergency phone numbers and procedures.
5. Provide one storage locker per employee.
6. Provide all other components indicated in the Asbestos Remediation.

F. Provide a completely watertight operational shower to be used for transit by cleanly dressed workers heading for the work area from the changing room, or for showering by workers headed out of the Work Area after undressing in the Equipment Room.

G. Construct room by providing a shower pan and 2 shower walls in a configuration that will cause water running down walls to drip into pan. Install a freely draining wooden floor in shower pan at elevation of top of pan.

1. Separate this room from the rest of the building with airtight walls fabricated of 6-mil polyethylene.
2. Separate this room from the Clean and Equipment Rooms with airtight walls fabricated of 6-mil polyethylene.
3. Provide showerhead and controls.
4. Provide temporary extensions of existing hot and cold water and drainage, as necessary for a complete and operable shower.
5. Provide a soap dish and a continuously adequate supply of soap and maintain in sanitary condition.
6. Arrange so that water from showering does not splash into the Clean or Equipment Rooms.
7. Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance from either inside or outside of the work area.
8. Provide flexible hose shower head.
9. Pump wastewater to drain and provide 20 micron and 5-micron wastewater filters in line to drain or wastewater storage. Locate filter hose inside shower unit so that water lost during filter changes is caught by shower pan and pumped to exterior filtering system.

H. Provide equipment room for contaminated area; work equipment, footwear and additional contaminated work clothing are to be left here. This is a change and transit area for workers. Separate this room from the work area by a 6-mil polyethylene flap doorway.

1. Separate this room from the rest of the building with airtight walls fabricated of 6-mil polyethylene.
2. Separate this room from the Shower Room and work area with airtight walls fabricated of 6-mil polyethylene.

I. Separate work area from the equipment Room by polyethylene barriers. If the airborne asbestos level in the work area is expected to be high, add an intermediate cleaning space between the Equipment room and the work area. Damp wipes clean all surfaces after each shift change.

2.05 EQUIPMENT DECONTAMINATION UNITS

A. In areas with only one access, it may be impossible to utilize a separate Equipment Decontamination Unit. In this case, all equipment and waste materials will exit through the Personnel Decontamination Chambers.

B. When two accesses to the work area are available, provide an Equipment Decontamination Unit consisting of a serial arrangement of rooms, Clean Room, Holding Room, Washroom for removal of equipment and material from work area. Do not allow personnel to enter or exit work area through Equipment Decontamination Unit.

C. Provide an enclosed shower unit located in work area just outside Washroom as an equipment, bag, and container cleaning station.

D. Provide Washroom for cleaning of bagged or containered asbestos containing waste materials passed from the work area. Construct Washroom of 2 by 4-inch (minimum) wood framing and polyethylene sheeting, at least 6-mil in thickness and located so that packaged materials, after being wiped clean can be passed to the Holding Room. Separate this room from the work area by flaps of 6-mil polyethylene sheeting, or rigid self-closing doors.

E. Provide Holding Room as a drop location for bagged ACM passed from the Washroom. Construct Holding Room of 2 by 4-inch (minimum) wood framing and polyethylene sheeting, at least 6-mil in thickness and located so that bagged materials cannot be passed from the Washroom through the Holding Room to the Clean Room.

F. Provide Clean Room to isolate the Holding Room from the building exterior. Construct Clean Room of 2 by 4-inch (minimum) wood framing and polyethylene sheeting, at least 6-mil in thickness and locate to provide access to the Holding Room from the building exterior. Separate this room from the exterior by flaps of 6 mil polyethylene sheeting, or rigid self-closing doors.

PART 3 - EXECUTION

3.01 SCOPE OF WORK

It is anticipated that the asbestos abatement project may be performed in several phases. It is the asbestos contractor’s responsibility to coordinate with the project schedule prepared by the General Contractor and shall comply with the commencement and completion dates allocated. Changing, decreasing, and increasing of phases, size, location, and scope of work shall not constitute compensation by the Owner or any of his representatives.

The Asbestos Project Monitor will record on a daily basis all quantities removed. The asbestos contractor will be required to do the same. Both the contractor and the monitor must sign all daily logs. No work will continue until all logs are signed daily. At the completion of the total project, should quantities removed were found to be less than the listed below, the asbestos contractor will be required to issue a credit to the owner based on unit prices or will be paid at the unit prices should quantities removed were found to be greater than the quantities listed below.

Location	Type of ACM	Approximate Quantities
Throughout	Vinyl Floor Tile and Mastic (Base Bid)	12,500 SF
	Vinyl Floor Tile and Mastic (Alternate)	15,000 SF
	Interior Windows	10 Total
	Interior Doors with Windows	33 Total
	Pipe and Hard Joint Insulation	650 LF
	Hidden Pipe and Hard Joint Insulation	750 LF
	Black Sinks	1 Total
	Speaker Boxes	20 Total
	Walls and Ceiling Demolition to Access ACM	1,500 SF
Gymnasium	Mastic under Hardwood Floor	2,800 SF
Boiler Room	Boiler Insulation	120 SF
	Duct Insulation	130 SF
	Pipe and Hard Joint Insulation	380 LF
	Generator Exhaust Insulation	30 LF

Specific Notes:

1. It is the Asbestos Contractor's responsibility to inspect the site and confirm condition and quantities prior to the submission of his/her bid package. It is also the Asbestos Contractor's responsibility to review the demolition drawings, notes and phasing configurations prepared by the Architect. The contractor must include in his/her bid the entire scope of work listed above. The Contractor must agree and accept all unit prices listed at the end of this section. Means and methods of removal will be at the discretion of the contractor with prior approval by the Designer. All work in this section shall be performed by the Asbestos Contractor at no additional cost to the Owner.
2. In all areas where ACM pipe and hard joint insulation has to be removed, ACM debris shall be included in the scope of work and shall be removed and disposed of as ACM at no extra cost to the Owner.
3. Remove and dispose as ACM of any pipe and hard joint insulation that might be found in concealed and hidden including all ACM debris.
4. Remove and dispose as ACM of all types of flooring materials listed above, including but not limited to multiple layers of vinyl floor tiles, carpet, resilient baseboard, stair treads, transition strips and mastic under all above items (Vinyl Floor Tile and Mastic). Removal must be done which leave substrate smooth (in similar condition to that which existed prior to Mastic application). The Contractor will be required to remove fixed objects to access to ACM. Multiple layers of flooring material are found. Should ACM found underneath objects not previously removed, the asbestos contractor willbe required to perform abatement at no additional cost to the owner for re-mobilization. The Asbestos Contractor will be required to submit a plan to the DEP to shot blast the floors at no additional cost to the Owner. The Asbestos Contractor, otherwise, will be required to remove the mastic by chemical and then shot blast the floor upon receipt of clearance air sampling.
5. Remove and properly dispose of interior windows and doors, caulking and all attachments. Caulking was found to contain asbestos and assumed to contain >1ppm of PCB's.
6. Disconnect, remove, and dispose as ACM of sinks.
7. Disconnect, remove, and dispose as ACM of speaker boxes.
8. The Contractor shall make spot demolition in walls, vertical soffits, and other related wall structures to access ACM found behind walls. ACM debris was found. Therefore, wall demolition must be performed under containment.
9. Remove and dispose as ACM of all thermal insulation in the boiler room.
10. Remove and dispose as ACM of hardwood floor, mastic, and paper. Removal must be done which leave substrate smooth (in similar condition to that which existed prior to Mastic application). The Contractor will be required to remove fixed objects to access to ACM. The Asbestos Contractor will be

required to submit a plan to the DEP to shot blast the floors at no additional cost to the Owner. The Asbestos Contractor, otherwise, will be required to remove the mastic by chemical and then shot blast the floor upon receipt of clearance air sampling.

3.02 JOB CONDITIONS

A. Do not commence asbestos abatement work until:
   l. Arrangements have been made for disposal of waste at an acceptable site. Submittal shall be made no later than the Document Submission Date.
   2. Arrangements have been made for containing and disposal of wastewater resulting from wet stripping or filtering through a 5-micron filter.

B. All materials resulting from abatement work, except as specified otherwise shall become the property of the Asbestos Contractor and shall be disposed of as specified herein.

C. Pre-clean all areas prior to commencement of any work.

D. Clean all routes used to transport waste.

3.03 INSPECTION AND PREPARATION

A. Examine the areas and conditions under which asbestos will be abated and notify the Asbestos Project Monitor in writing of conditions detrimental to the proper and timely completion of the work.

B. Before any work commences, post danger signs in and around the Work Area to comply with 29 CFR 1926.1101 (k)(l) per federal and state regulations.

3.04 WORK PROCEDURE

A. Perform asbestos related work in accordance with 29CFR 1926.1101 and as specified herein. Use wet removal procedures. Personnel shall wear and utilize protective clothing and equipment as specified herein. Personnel of other trades not engaged in the removal and demolition of asbestos shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection provisions of this specification are complied with by the trade personnel. Provide and post, in the Equipment Room and the Clean Room, the decontamination and work procedures to be followed by workers, as described hereinafter.

B. Each worker and authorized visitor shall, upon entering the job site, remove street clothes in the Clean Change Room and put on a respirator and clean protective clothing before entering the equipment room or the work area. All workers shall remove gross contamination before leaving the work area. All clothing such as coveralls, head covers, boots shall be removed and properly disposed of before leaving equipment room. With the exception of bathing suites and respirators, the workers shall proceed to the Shower Room. Under the shower, respirators shall be removed and cleaned. Cleaned respirators shall be placed in suitable clean plastic bags and carried by employees to Clean Room. Soap, towels shall be furnished by the Asbestos Contractor. The Asbestos Contractor shall maintain proper sanitary conditions. The Asbestos Contractor's designated competent person shall insure that these practices are being adhered to.

C. Following showering and drying off, each worker and authorized visitor shall dispose of towels as contaminated waste and proceed directly to the Clean Change Room and dress in clean clothes at the end of each day's work, or before eating, smoking, or drinking. Before re-entering the work area from the Clean Change Room, each worker and authorized visitor shall put on the applicable respirator and shall dress in clean protective clothing. Contaminated work footwear shall be stored in the equipment room when not in use in the work area. Upon completion of asbestos abatement, dispose of footwear as contaminated waste.

D. Contaminated work footwear shall be stored in the equipment room when not in use in the work area. Upon completion of asbestos abatement, dispose of footwear as contaminated waste or double bag for use at next site.

E. Workers removing waste containers from the Equipment Decontamination Enclosure shall enter the holding area from outside wearing a respirator and dressed in clean coveralls. No worker shall use this system as a means to leave or enter the washroom or the work area.

F. Workers shall be fully protected with respirators and protective clothing immediately prior to the first disturbance of asbestos containing or contaminated materials and until final cleanup is completed. This includes the removal of any equipment in contact with ACM such as lights, HVAC grills and other related structures.

3.05 PREPARATION OF THE WORK AREA

A. Seal off the work area by sealing large openings such as open doors, elevator doors, and passageways with a critical barrier. The critical barrier shall constitute the outermost boundary of the asbestos abatement project work area. Plastic sheeting on open framing is not a suitable critical barrier. Critical barriers may be erected of a suitable solid construction material such as plywood, sheetrock, gypsum board, or other related materials.

B. Prior to any asbestos abatement work, clean the proposed work areas using HEPA filtered vacuum equipment and wet cleaning methods as appropriate. Methods that raise dust, such as dry seeping or vacuuming with equipment not equipped with HEPA filters will not be permitted. Dispose of all cloths, which are used for cleaning as contaminated waste.

C. Place all tools, scaffolding and staging necessary for the work in the area to be isolated prior to erection of plastic sheeting temporary enclosure.

D. Shut down electric power. Provide temporary power and lighting and ensure safe installation of temporary power sources and equipment per applicable electrical code requirements. Provide 24-volt safety lighting and provide ground-fault interrupter circuits as power source for lights and electrical equipment.

E. Seal off all openings, including but not limited to corridors, doorways, windows, skylights, ducts, grills, diffusers, and any other penetrations of the work areas, with 6-mil plastic sheeting and sealed with tape.

F. Prior to any abatement activities seal all floor and ceiling openings or penetrations that have not already been sealed. This includes penetrations through ceiling and floor slabs, both empty holes and holes accommodating items such as cables, pipes, ducts, conduit and expansion joints in floors and wall and floor slab assemblies.

G. Use combination fire stop foam and fire stop sealant equivalent to Dow Corning Fire Stop Foam and Dow Corning Fire Stop Sealant. Material shall be applied in accordance with manufacturer's recommendations.

H. Maintain emergency and fire exits from the work areas, or establish alternative exits satisfactory to the local fire officials. Coordinate work with local fire and police departments, and Asbestos Project Monitor.

I. Shut down and isolate heating, cooling, ventilating air systems in the contaminated areas to prevent contamination and fiber dispersal to other areas of the structure. During the work, seal vents within the work area with solid barriers, such as plywood and tape and plastic sheeting, or as indicated on the drawings.

J. Remove all HVAC system filters. Pack disposable filters in sealable double 6 mil plastic bags for burial in the approved waste disposal site; replace with new filters after final cleanup. Wet clean permanent filters; reinstall after final cleanup.

K. Before work is begun, clean all items, which can be removed without disrupting the asbestos material. Pre-clean movable furniture, [carpeting, clocks, speakers, books, and other objects] within the proposed areas using HEPA filtered vacuum equipment and/or wet cleaning methods as appropriate; remove such objects from work areas to a temporary location.

L. Pre-clean non-removable furniture, book shelving, equipment, heat fans, fire alarms, pipes, ductwork, wires and conduits, lockers, skylights, speakers, and other fixed objects within the proposed work areas, using HEPA filtered vacuum equipment and wet cleaning methods as appropriate prior to abatement activities, and enclose with minimum 6 mil plastic sheeting sealed with tape.

M. Remove and clean all ceiling mounted objects, such as lights, HVAC grills and other items not previously sealed off, that interfere with asbestos abatement. Use localized water spraying or HEPA filtered vacuum equipment during fixture removal to reduce fiber dispersal.

N. The Asbestos Contractor will be required to supply a certified plumber to be available should any questions or problems arise.

3.06 MAINTENANCE OF ENCLOSURE SYSTEMS

A. Ensure that barriers and plastic linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery. Visually inspect enclosures at the beginning of each work period.

B. Use smoke methods to test effectiveness of barriers when directed by the Asbestos Project Monitor.

3.07 CONTROL ACCESS

A. Permit access to the work area only through the Decontamination Unit. All other means of access shall be closed off, warning signs displayed on the clean side of the sealed access.

B. Large openings such as open doorways and passageways shall be sealed as a critical barrier. The critical barrier shall constitute the outmost boundary of the asbestos abatement work area.

C. Plastic sheeting on open framing is not a suitable critical barrier. All cracks, seams, and openings in critical barriers shall be caulked or otherwise sealed, so as to prevent the movement of asbestos fibers out.

3.08 ISOLATION OF WORK AREA

A. Completely separate the work area from other portions of the building and the outside by sheet plastic barriers at least 6 mil in thickness.

B. Individually seal all ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, convectors and speakers, and other openings into the work area with duct tape alone or with polyethylene sheeting at least 6 mil in thickness, taped securely in place with duct tape. Maintain seal until all work including work area decontamination is completed. All lighting fixtures shall have had power shut off.

C. Provide sheet plastic barriers at least 6-mil in thickness needed to complete seal openings from the work area into adjacent areas. Seal the perimeter of all sheet plastic barriers with duct tape.

3.09 COVERING OF FLOOR AND WALL SURFACES

A. Clean all contaminated furniture, equipment, and or supplies with a HEPA filtered vacuum cleaner or by wet cleaning prior to being moved or covered. All equipment, furniture, stored items in work area is to be deemed contaminated unless specifically declared as uncontaminated in writing by the Asbestos Project Monitor. Clean all surfaces in work area with a HEPA filtered vacuum of by wet wiping prior to the installation of any sheet plastic.

B. Cover floor of work area with 2 individual layers of clear polyethylene sheeting, each at least 6 mil in thickness, turned up walls at least 12 inches. Form sharp right angle-bend at junction of floor and wall so that there is no radius, which could be stepped on causing the wall attachment to be pulled loose. Duct tape all seams in floor covering. Locate seams in top layer six feet from, or at right angles to, seams in bottom layer. Install sheeting so that top layer can be removed independently of bottom layer.

C. Remove all general construction items such as cabinets, casework, doors and window trim, moldings, ceilings, and trim which cover the surface of the work to prevent interference with the work. Clean, decontaminate and reinstall, unless otherwise indicated, all such materials, upon completion of all removal work with materials, finishes, and workmanship to match existing installations before start of work.

D. Cover all walls in work area with two (2) layers of polyethylene sheeting, at least 6- mil in thickness, mechanically supported and sealed with duct tape. Tape all joints including the joining with the floor covering with duct tape or as otherwise indicated on the Asbestos Remediation or in writing by the Asbestos Project Monitor. There shall be no seams in the plastic sheet at wall to floor joints.

E. If the enclosure barrier is breached in any manner that could allow the passage of asbestos debris or airborne fibers, then add affected area to the work area, enclose it and decontaminate it.

3.10 NEGATIVE PRESSURE

A. Establish negative pressure in the work area by installation of High Efficiency Particulate Air (HEPA) filter air-purifying devices. Comply with ANSI Z9.2, Local Exhaust Ventilation Requirements. Maintain system in operation 24 hours per day until decontamination of the work area is completed and area has been certified clean by air monitoring tests and visual inspections. Discharge of asbestos fibers to the outside of the building will not be permitted.

B. Size negative air pressure system(s) to provide a minimum of one air change every l5 minutes for the area under negative pressure. Locate the exhaust unit(s) so that makeup air enters the work area primarily through the decontamination unit and traverses the work area as much as possible. The intent is to provide the air change specified in each work area (room), not just the specified negative pressure. Place the end of the unit or its exhaust duct through an opening in the plastic barrier or wall covering. Seal the plastic around the unit or duct with tape.

C. The system shall maintain an air pressure differential of minus 0.02 inch of water. Test the negative pressure system prior to any abatement actions to ensure that the 0.02-inch differential is present. The Asbestos Project Monitor may require the use of ventilation smoke tubes to check the system performance.

3.11 REMOVAL OF ASBESTOS CONTAINING MATERIALS

A. Thoroughly wet ACM to be removed prior to stripping to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of amended water or removal Encapsulant. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow time for water or removal Encapsulant to penetrate material thoroughly. If a removal Encapsulant is used, apply in strict accordance with manufacturer's written instructions.

B. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.

C. Remove saturated ACM in small sections from all areas. Do not allow material to dry out. As it is removed, simultaneously pack material while still wet into disposal bags. Twist neck of bags bend over and seal with minimum three wraps of duct tape. Clean outside and move to wash down station adjacent to material decontamination unit.

D For the removal of pipe and joint insulation, the density of asbestos containing pipe covering seldom allows the material to be removed in a completely wet state. However, every attempt should be made to keep the insulation material as wet as possible to prevent release of asbestos fibers.

E. Cut the cloth covering on the pipe insulation along the top seam to allow wetting of the asbestos insulation. Do not allow the pipe insulation to fall to the ground or adjacent surfaces. Wet the insulation material and immediately place in a double 6 mil, minimum thickness labeled plastic bag.

F. In certain areas, asbestos pipe insulation will be removed with glove-bags (with prior approval by the Asbestos Project Monitor).
   1. Seal all critical barriers.
   2. Pre-clean if necessary and place one layer of polyethylene under the pipe to be removed.
   3. Negative air machines with HEPA filtration will be used in the area.
   4. Glove bags will be smoke tested.

5. Place necessary tools into pouch located inside glove-bag. This will usually include bone saw, utility knife, rags, scrub brush, wire cutters, tin snips, and pre-wetted cloth.
6. Place one strip of duct tape along the edge of the open top slit of glove-bag for reinforcement.
7. Place the glove bag around section of pipe to be worked on and staple top together through reinforcing duct tape. Next, duct tape the ends of glove-bag to pipe itself, where previously covered with plastic or duct tape.
8. Place additional layers of tape along the top of the glove-bag to seal the staple holes and to securely support the bag on the pipe.
9. Fill each bag with 2 inches of water to thoroughly wet the removed insulation.
10. Attach vacuum hose through port in bag and tape tightly to prevent leakage.
11. Insert spray nozzle into bag and tape tightly to prevent leakage.
12. One person places his hands into the long-sleeved gloves while the second person directs garden sprayer at the work.
13. Use bone saw, if required, to cut insulation at each end of the section to be removed. A bone saw is a serrated heavy gauge wire with ring-type handles at each end. Throughout this process, spray amended water or removal Encapsulant on the cutting area to keep dust to a minimum.
14. Remove insulation using putty knives or other tools. Place pieces in bottom of bag without dropping.
15. Using nylon scrub brush, rags, and water scrub and wipe down the exposed pipe.
16. Wipe down the inside of the bag with the rags. Remove the water nozzle and tape shut.
17. Encapsulate the exposed ends and cover any exposed ends of pipe insulation with the re-wettable clothe. This shall be done prior to removing the bag.
18. Place the cleaned tools either into the next glove bag or put into the glove and pulled out. Twist the glove, tape at least twice and cut through the tape. The tools can be dropped into a bucket of water to clean them.
19. Twist the bag several times and turn on HEPA vacuum to remove the air. Tape the twist several times.
20. Slip a 6-mil disposal bag under the glove-bag and while running the vacuum sufficiently to collapse the bag, cut the glove-bag off.
21. Encapsulate all exposed pipe and elbows to lock down any remaining fibers.
22. Remove disposable suits and place these into bag with waste.
23. Collapse the disposal bag with a HEPA vacuum, twist top of bag, seal with at least 3 wraps of duct tape, bend over and seal again with at least 3 wraps of duct tape.

3.12 DECONTAMINATION OF WORK AREA

A. Maintain premises and public properties free from accumulation of waste, debris, and rubbish, caused by operations. Remove visible accumulations of asbestos material and debris. Wet clean all surfaces within the work area.

B. Remove the plastic sheets from walls and floors only. Take proper care in folding up plastic sheeting to minimize dispersal of residual asbestos containing debris.

C. Leave the windows, doors, and HVAC vents sealed. Maintain HEPA filtered negative air pressure systems, air filtration and decontamination enclosure systems in service.

D. Remove all debris from floor of work area. This includes all trash, scraps of lumber, pipes, and all visible asbestos debris. The asbestos debris is primarily deteriorated pipe insulation that has fallen to the ground. Dispose of all debris removed as asbestos contaminated waste. HEPA vacuum the entire floor.

E. Clean all surfaces in the work area and any other contaminated areas with water and with HEPA filtered vacuum equipment. After cleaning the work area, wait 24 hours to allow for settlement of dust, and again wet clean and clean with HEPA filtered vacuum equipment all surfaces in the work area. After completion of the second cleaning operation, perform a complete visual inspection of the work area to ensure that the work area is free of visible asbestos debris. The negative pressure system may be shut down only after clean air has been achieved.

F. Include sealed drums and all equipment used in the work area in the cleanup and remove from work areas, via the equipment decontamination enclosure system, at an appropriate time in the clean sequence.

G. Conduct cleaning and disposal operations to comply with applicable ordinances and antipollution laws. Do not burn or bury rubbish and waste materials on job site. Do not dispose of volatile wastes in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

H. Store volatile wastes in covered metal containers during work hours and remove from premises at end of workday. Prevent accumulation of wastes, which create hazardous conditions. Provide adequate ventilation during use of volatile or noxious substances.

I. If the Asbestos Project Monitor, within 24 hours after the second cleaning, finds visible accumulations of asbestos debris in the work area, repeat the wet cleaning until the work area is in compliance, at no additional expense to the Owner.

J. Remove the first layer of plastic sheet from walls and floors only. Take proper care in folding up plastic sheeting to minimize dispersal of residual asbestos containing debris.

K. Leave the windows, doors, and HVAC vents sealed. Maintain HEPA filtered negative air pressure systems, air filtration and decontamination enclosure systems in service.

L. Following the final visual inspection by the ASBESTOS PROJECT MONITOR, after the removal of asbestos-containing materials and decontamination of work areas, and while space enclosures systems remain in place, seal all surfaces from which asbestos-containing material have been removed to assure immobilization of any remaining fibers. Use a colored sealant so that complete coverage may be ensured by a visible inspection by the ASBESTOS PROJECT MONITOR to verify that asbestos-containing material has been adequately removed. Apply sealer in accordance with manufacturer's recommendations using airless spray equipment.

M. Clearance air samples will be taken by the ASBESTOS PROJECT MONITOR using aggressive air sampling. Analysis will be made using Phase Contrast Microscopy or Transmission Electron Microscopy.

N. Clean all access routes used to transport ACM.

3.13 WORK AREA CLEARANCE

A. The work is complete when the work area is visually clean and airborne fiber levels have been reduced to the level specified below. When this has occurred, the Asbestos Contractor will notify the Asbestos Project Monitor that the area is ready for clearance.

B. The number and volume of air samples taken, and analytical methods used by the Asbestos Project Monitor will be in accordance with applicable regulations.

C. The Owner will pay for the initial testing required for clearance. Should the initial testing fail, the Contractor will reimburse the Owner for the cost of all additional testing based on $90.00 per hour for project monitor, $30.00 per each PCM and $150.00 for each TEM air sample.

3.14 DISPOSAL OF ACM AND ASBESTOS CONTAMINATED WASTE

A. To prevent exceeding available storage capacity on site, remove sealed and labeled containers of asbestos waste and dispose of such containers at an authorized disposal site in accordance with the requirements of disposal authority.

B. Comply with 29 CFR 1926.1101.

C. Seal all asbestos and asbestos contaminated waste material with double thickness 6-mil, sealable plastic bags. Label the bags; transport and dispose of all in accordance with the applicable OSHA and EPA regulations. At the conclusion of the job, place all polyethylene material, tape, cleaning material and clothing in the plastic lined drum. Seal, correctly label, and dispose of as asbestos waste material.

D. Transport the bags to the approved waste disposal site. Asbestos Contractor shall obtain trip tickets at the landfill to document disposal of asbestos containing materials. A form shall be signed, not initialed, by all parties. Copies of all trip tickets shall be submitted to the Asbestos Project Monitor.

E. If a rental vehicle is used to transport asbestos waste, Asbestos Contractor shall provide to the vehicle's owner a written statement as to the intended use of the vehicle. A copy of such notice, signed by the vehicle owner, shall be provided to the Asbestos Project Monitor prior to transporting materials in the vehicle. Two layers of 6-mil plastic sheet shall be placed on the floor and walls of the rental vehicle prior to loading any containers of asbestos waste.

F. Consider wastewater from showers and sinks to be contaminated waste and dispose of in accordance with this Section unless water has been filtered through a 5-micron filter.

3.15 DISPOSAL OF NON-CONTAMINATED WASTE

A. Remove from the site all non-contaminated debris and rubbish resulting from demolition operations. Transport materials removed from demolished areas and dispose of off site in a legal manner.

B. During progress of work, clean site, and public properties, and dispose of waste materials, debris, and rubbish. Provide on-site containers for collection of waste materials, debris, and rubbish. Remove waste materials, debris, and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.

3.19 UNIT PRICES

A. All quantities listed in 3.01 are approximate. It is the Asbestos Contractor's responsibility to inspect the site and confirm condition and quantities prior to the submission of his/her bid package. It is also the Asbestos Contractor’s responsibility to review the demolition drawings, notes and phasing configurations.

B. The contractor must include in his/her bid the entire scope of work listed in 3.01. The Contractor must agree and accept all unit prices listed below. Means and methods of removal will be at the discretion of the contractor with prior approval by the on-site monitor and designer.

C. Units prices listed below are inclusive of all related costs.

		Addition	Deduction
1.	Flooring Material	$ 4.50 per SF	$ 3.75 per SF
2.	Pipe Insulation	$ 25.00 per LF	$ 20.00 per LF
3.	Hard Joint Insulation	$ 25.00 Each	$ 20.00 Each
4.	Ceiling and Wall Demolition	$ 2.00 per SF	$ 1.50 per SF

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 her/his 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. Section 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL:
   a. Waste management and recycling.
5. Section 210001 - 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.
6. Section 220001 - 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.

7. Section 230001 - 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.
8. Section 260001 - 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.
9. 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 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work in this Section includes the cast-in-place concrete work as shown on the Contract Drawings and specified herein, including, but not limited to, the following:

1. Furnishing, placing, finishing, curing and protection of all plain and reinforced concrete (normal weight and light weight), above and below grade, for buildings and site-related cast-in-place concrete.
2. Furnishing and erection of formwork, and removal of same.
3. Furnishing and placing of reinforcing steel, including dowels into masonry walls, welding to structural steel and related positioning and securing of all embedded accessories.
4. Furnishing and installation of admixtures, concrete surface conditioners, wedge inserts, masonry and dovetail anchors, flashing reglets and similar items in conjunction with concrete work.
5. Furnishing and installation of approved non-shrink cement grout under base and leveling plates.
6. Furnishing and installation of vapor barriers/retarders under slabs cast on grade.
7. Furnishing and installation of insulation under slabs cast on grade per the requirements in Section 07 21 00 – THERMAL INSULATION.
8. Furnishing and installation of pea-stone concrete fill at depressed slab areas and metal pan stairs and landings as indicated in the drawings.
9. Installation of items furnished by other Sections such as anchors, bolts, plates and embedded items required to be cast into concrete.
10. Make provisions in forms for proper location and installation of pipe sleeves, duct openings, keys, chases and electric boxes, as required by other trades.
11. Accessories as needed for a complete installation.

B. INTENT OF WORK

1. Except as specified otherwise herein, concrete shall be batched, mixed, placed, tested and cured in accordance with the American Concrete Institute's "Specifications for Structural Concrete for Buildings" ACI 301.
2. Subcontractor shall schedule his Work and notify all trades in ample time so that provisions for their Work can be made without delaying the progress of the Project.
3. It is the intention of the Drawings and Specifications to produce concrete which will present an acceptable finished appearance. Imperfections of material or Workmanship shall be corrected as directed by the Engineer's direction, at no additional cost to the Owner.
4. All of the Work that is to be inserted in the forms for attachment of other work is not described in detail. Sub-Contractor shall carefully examine all drawings and other Sections of these specifications for the extent and detail of all such work and coordinate this work with other trades.
5. The General Contractor shall be responsible to insure that all concrete surfaces are completely free of any conditions which will adversely affect its finished appearance or the application of a specified finish.
6. Failure to comply with these requirements will require removal of sufficiently large Section of the Work, as determined by the Architect and Engineer, in order to properly integrate the Section to be replaced with the architectural and structural requirements of the total

project. All such removal and replacement shall be made at the expense of the Subcontract at no additional cost to the Owner.

1.2 RELATED 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, General Contractor's Supplementary Conditions, and applicable parts of Division 01 are included as part of this Section.

B. Carefully examine all of the Contract Documents for requirements which affect the Work of this Section.

C. Work described in other Sections which contain requirements applicable to the work of this Section, or with which this subcontractor must coordinate the Work of this Section include, but are not limited to the following:

1. Section 00 31 00.10 – GEOTECHNICAL REPORT
2. Section 01 45 23 – TESTING AND INSPECTING SERVICES.
3. Section 01 74 00 – CONSTRUCTION WASTE MANAGEMENT: Procedural and administrative requirements for construction and demolition recycling.
4. Section 04 20 00 – UNIT MASONRY: reinforcing placement for CMU partitions.
5. Section 05 12 00 – STRUCTURAL STEEL FRAMING
6. Section 05 31 00 – STEEL DECKING
7. Section 05 50 00 – METAL FABRICATIONS: for trench frames and covers, railing base connections, cast stair nosings and other items for embedment in concrete.
8. Section 05 51 00 – METAL STAIRS: for thickened slabs at posts and stringer bases, and boxouts for stringer attachment to the structure.
9. Section 07 21 00 – THERMAL INSULATION: requirements for insulation furnished and installed by this Section under concrete slabs on grade.
10. Section 09 30 00 - TILING
11. Section 09 65 00 - RESILIENT FLOORING AND ACCESSORIES
12. Section 11 66 20 – ATHLETIC EQUIPMENT – coordination of sleeves to be cast in to concrete slabs for equipment posts.
13. Section 12 48 13 – ENTRANCE FLOOR MATS AND FRAMES – coordination of recesses required for entry mat / grate recesses.
14. Section 14 21 00 - ELECTRIC TRACTION ELEVATORS – coordination of pit depth and sump requirements.
15. Section 21 00 00 – FIRE PROTECTION – coordination of housekeeping curbs required and sleeve penetrations of concrete slabs.
16. Section 22 00 00 – PLUMBING– coordination of housekeeping curbs required and sleeve penetrations of concrete slabs.
17. Section 23 00 00 – HEATING, VENTILATING AND CONDITIONING (HVAC) – coordination of housekeeping curbs required and sleeve and duct penetrations of concrete slabs.
18. Section 26 00 00 – ELECTRICAL – coordination of housekeeping curbs required and sleeve penetrations of concrete slabs.
19. Section 31 20 00 - EARTH MOVING
20. Section 32 13 16 – CONCRETE PAVEMENT
21. Section 32 31 00 - CHAIN LINK FENCES AND GATES: Site features requiring cast-in-place concrete footings

1.3 REFERENCE STANDARDS

A. Except as modified by the requirements specified herein and/or the details on the Drawings, all Work included in this Section shall conform to the applicable provisions of the following codes, standards and references as well as those specified in Section 01 41 00 – REGULATORY REQUIREMENTS and in the latest edition of the Massachusetts State Building Code (MSBC):

1. ASTM International; www.astm.org

   a. A185/A185M-07 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
   b. A497/A497M-07 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
   c. A615/A615M-07 – Standard Specification for Deformed and Plain Billet-steel Bars for Concrete Reinforcement
   d. A706/A706M-06a – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
   e. C33-03 – Standard Specifications for Concrete Aggregates
   f. C94/C94M-06 – Standard Specification for Ready Mix Concrete
   g. C150-05 – Standard Specification for Portland Cement
   h. C171-92 – Standard Specification for Sheet Materials for Curing Concrete
   i. C260-06 – Standard Specification for Air-entraining Admixtures for Concrete
   j. C309-93 – Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete
   k. C330-05 – Lightweight Aggregates for Structural Concrete
   l. C494/C494M-05a – Standard Specification for Chemical Admixtures for Concrete
   m. C618-05 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
   n. C685/C685M-01 – Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
   o. C989/C989M-12a – Standard Specification for Slag Cement for Use in Concrete and Mortars
   p. C1017/C1017M-03 – Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete

B. ACI. American Concrete Institute; www.concrete.org

1. ACI 117-90 (Reapproved 2002) – Specifications for Tolerances of Concrete Construction and Materials
2. ACI 121R-04 – Quality Management System for Concrete Construction
3. ACI 207.1R-96 – Mass Concrete
4. ACI 211.5R-01 – Guide for Submittal of Concrete Proportions
5. ACI 212.3R-04 – Chemical Admixtures for Concrete
6. ACI 212.4R-04 – Guide for the Use of High-Range Water-Reducing Admixtures (Superplasticizers) in Concrete
7. ACI 213R-03 – Guide for Structural Lightweight Aggregate Concrete
8. ACI 224R-01 – Control of Cracking in Concrete Structures
9. ACI 224.3R-95 (Reapproved 2001) – Joints in Concrete Construction
10. ACI 233R-03 – Slag Cement in Concrete and Mortar
11. ACI 301-05 – Specifications for Structural Concrete for Buildings
12. ACI 302.1R-04 – Guide for Concrete Floor and Slab Construction
13. ACI 302.2R-06 – Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
14. ACI 303R-04 – Guide to Cast-In-Place Architectural Concrete Practice
15. ACI 303.1-97 – Standard Specification for Cast-In-Place Architectural Concrete
16. ACI 304R-00 – Guide for Measuring, Mixing, Transporting and Placing Concrete
17. ACI 304.2R-96 – Placing Concrete by Pumping Methods

18. ACI 304.5R-91 (Reapproved 1997) – Batching, Mixing, and Job Control of Lightweight Concrete
19. ACI 305R-88 (Reapproved 2002) – Hot Weather Concreting
20. ACI 306R-88 (Reapproved 2002) – Cold Weather Concreting
21. ACI 308R-01 – Standard Practice for Curing Concrete
22. ACI 309R-96 – Guide for Consolidation of Concrete
23. ACI 309.3R-92 (Reapproved 1997) – Guide to Consolidation of Concrete in Congested Areas
24. ACI 315 – ACI Detailing Manual - 2004
25. ACI 318-14 – Building Code Requirements for Structural Concrete
26. ACI 336.3R-93 (Reapproved 1998) – Design and Construction of Drilled Piers
27. ACI 347-04 – Guide to Formwork for Concrete
28. ACI 351.1R-99 – Grouting between Foundations and Bases for Support of Equipment and Machinery
29. ACI 355.2-04 – Evaluating the Performance of Post-Installed Mechanical Anchors in Concrete
30. ACI 503R-93 (Reapproved 1998) – Use of Epoxy Compounds with Concrete
31. ACI 503.4-92 (Reapproved 2003) – Standard Specification for Repairing Concrete with Epoxy Mortars
32. ACI 504R-90 (Reapproved 1997) – Guide to Sealing Joints in Concrete Structures
33. ACI 544.3R-93 (Reapproved 1998) – Guide for Specifying, Proportioning, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete
34. ACI 546R-04 – Concrete Repair Guide

C. ANSI – American National Standards Institute

1. ANSI/ASCE 9-91 – Standard Practice for the Construction and Inspection of Composite Slabs

D. AWS – American Welding Society

1. AWS D1.1-04 – Structural Welding Code-Steel
2. AWS D1.4-98 – Structural Welding Code-Reinforcing Steel

E. CRSI (MSP) – Manual of Standard Practice (28th edition)

F. MSBC – The latest currently enforced edition of the Massachusetts State Building Code

G. IBC – International Building Code, 2015, as amended by the MSBC.

H. ADA – Americans with Disabilities Act 2010.

I. MAAB – Massachusetts Architectural Access Board.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination per Section 01 30 00 – ADMINISTRATIVE REQUIREMENTS, and as follows:

1. Coordinate concrete testing with Independent Testing Agency.
2. Coordinate concrete inserts with all trades providing them to this subcontractor for installation.

B. Pre-installation Meetings required per Section 01 30 00 – ADMINISTRATIVE REQUIREMENTS for foundations and slabs, and as follows: Installer of the Work of this Section is also required to attend pre-installation conference specified under Section 04 20 00 – UNIT MASONRY.

1.5 SUBMITTALS

A. Refer to Section 01 30 00 – ADMINISTRATIVE REQUIREMENTS for submittal provisions and procedures.

B. General

1. Review of submittals is for general conformance with the design concept of the project and information shown on the contract documents only. The General Contractor is responsible for conforming, correlating and coordinating dimensions in the field for tolerance, clearances, quantities, fabrication and installation processes, means and methods of construction, coordination of this work with other trades and performing work in a safe and satisfactory manner.
2. Prior to final approval of Shop Drawings for exposed architectural concrete surfaces the Mock-up specified herein shall be completed and approved. Any modifications of the Mock-up formwork shall be incorporated into the Shop Drawings and other submittals.

C. Shop Drawings: Comply with ACI 315 for reinforcement detailing, fabricating, bending and placing concrete reinforcement. Show bar schedules, stirrup spacing, bent bar diagrams and arrangement of concrete reinforcement.

1. All reinforcing Shop Drawings for concrete and masonry walls shall be shown on wall elevations with a scale of 1/4 in. = 1 ft. 0 in.
2. Include special reinforcing required for openings through concrete structures.
3. Submit shop drawings of all formwork for architecturally exposed concrete (Concrete Exposed to View) showing cone tie patterns.
4. Submit Drawings of formwork design for review of form types, location of joints and ties, details of reveals, chamfers, textured surfaces and other visual aspects of concrete.
5. Submit detailed drawings showing locations of all concrete joints (construction, contraction and expansion), curbs, depressions, sleeves and openings.
6. Submit plans and other details showing sequence of concrete pours. This will be reviewed only for impact on the performance of the completed structure.
7. Submit detail drawings indicating position of waterstops and details to be used for all water tight construction.
8. Submit shop drawings detailing Mock-up if a Mock-up has been specified.
9. Submit shop drawings that include wall elevations, section details and dimensions for all walls, footings and any other concrete element.
10. Submit shop drawings that include saw-cut patterns on slab-on-grade and joint details at columns.

D. Concrete Curing and Protection:

1. Submit to the Architect/SER in accordance with the requirements of the Contract Documents, detailed methods proposed for use for curing and protection prior to commencement of concrete work, including
2. Cold and Hot Weather protection plan
3. Curing protection plan for footings, walls, slabs-on-grade, slabs-on-deck, beams, columns, etc.

E. Concrete Mix Design: Submit proposed mix designs for each class of concrete indicated in section 2.02. Include the following:

1. Copies of mix designs: Mix designs shall be prepared by an independent testing laboratory.
2. The mix design submittal shall list:

3. All materials, admixtures and their proportions.
4. Water and cement content, water cementitious material ratio, slump and combined aggregate gradation (percent retained on every sieve size).
5. Compressive Strength: Documentation of how the strength was determined.
6. Information on concrete materials as per paragraph 4.1.2.3 of ACI 301.
7. Whether mix is appropriate for pumping.
8. Indicate where each mix will be used.
9. This submittal shall include the results of all testing performed to qualify the materials and to establish the mix design. Include all calculations and tests required by ACI 318 Section 5.3.
10. Test results of total chloride in content.
11. Where shrinkage limit is specified, submit shrinkage test results.
12. For lightweight aggregate used, submit test results per ASTM C330-03.
13. For normal weight aggregate, submit test results per ASTM C33-05.

F. Product Data:

1. Submit product data for proprietary materials, the following products and those requested by the Architect and/or SER showing compliance with project specifications, manufacturer's recommendations, as well as known limitations. Provide certification that the following materials conform to the standards referenced in this section including, but not limited to:
2. Reinforcement
3. Form work and accessories
4. Admixtures
5. Cementitious materials used in mix design
6. Patching compounds
7. Water-stops
8. Joint systems
9. Curing materials
10. Dry-shake finish materials
11. Non-shrink grout

G. Certifications: Submit certification by the manufacturers that each admixture conforms to requirements specified in this section and that the admixtures are compatible with one another.

H. Submit cement mill tests.

I. Upon completion of the concrete Work, deliver the records of concrete placement and the concrete batch tickets to the Architect and/or SER.

J. Warranty:

1. Provide copies of manufacturers' actual warranties for all materials to be furnished under this Section, clearly defining all terms, conditions and time periods for the coverage thereof.

K. Samples:

1. Submit samples and/or descriptive literature of materials, products and methods as noted herein and as otherwise requested by the architect and/or the SER.
2. Prepare a 4 ft. – 0 in. x 4 ft. – 0 in. x 0 ft. – 6 in. thick sample on the site for the polished concrete flatwork using the approved concrete mix design, admixtures, sealers and joint sealers, a minimum of one month prior to casting the slabs, for approval by the Architect.
3. Submit three representative samples of each concrete constituent including, but not limited to:

4. Admixtures and topical treatments
5. Form ties (including cones) and spreaders
6. Accessories for reinforcement
7. Reglets
8. Form release agent
9. Pre-molded joint filler
10. Dovetail anchors
11. Vapor retarder
12. Under-slab rigid insulation board
13. Non-shrink cement grout
14. Threaded, Wedge, and Slotted inserts
15. Bulkhead or control joint breakaways
16. Control joint pull out reglets

1.6 QUALITY ASSURANCE

A. Qualification of Workmen:

1. Provide one or more persons who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly trained and experienced in the types of concrete specified and who shall direct all work performed under this Section.
2. The individual directing this work shall have at least five years of foreman experience with 'As-cast' Architectural concrete.
3. For finishing of exposed surfaces of the exposed concrete, use only thoroughly trained and experienced journeymen concrete finishers.
4. Product(s) Technical Representative: Provide services of a qualified technical representative approved by reinforcement manufacturer to instruct concrete supplier in proper batching and mixing procedures.

B. Mock-ups per SECTION 01 40 00 – QUALITY REQUIREMENTS, and as follows: Architectural Concrete exposed-to-view

1. Provide full scale three-dimensional assemblies utilizing final specified materials and final production techniques, constructed to be fully tested to ensure that the systems meet the performance requirements of the Specification by application of the maximum applied loads, in-situ conditions and structural movements.
2. Build Mock-up in location and size acceptable to Architect of type specified.
3. Notify design professional seven days in advance of time when mock-up will be installed for approval viewing.
4. Demonstrate the anticipated range of materials, workmanship and finish expected.
5. Obtain approval in writing before commencing work. Mock-up may not be included as a part of the finished project.
6. Protect the approved mock-up during construction period as it will be used to comparatively judge the finished installation

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ACI, concrete plant's instructions and recommendations, Section 01 60 00 – PRODUCT REQUIREMENTS, and as follows:

1. Handle and store materials separately in such manner as to prevent intrusion of foreign matter, segregation, or deterioration.
2. Do not use frozen materials or those containing ice.
3. Store bags of concrete or grout indoors.

4. Remove improper and rejected materials immediately from point of use.
5. Cover materials, including steel reinforcement and accessories, during construction period.
6. Stockpile concrete constituents properly to assure uniformity throughout project.

PART 2 - PRODUCTS

2.1 CONCRETE CONSTITUENTS

A. Cement: Shall be American-made Portland Cement; and conform to chemical and physical requirements of ASTM C150 for Type I for exposed concrete and Type II, low alkali, standard gray color for all other work.

1. 30% replacement of cementitious materials with fly ash or slag is to be used to comply with the sustainable design requirements, except for all slabs.
2. Fly ash or slag used in interior concrete slab-on-grade or elevated slab construction shall be 15% replacement of cement.
3. High early strength cement conforming to ASTM C150 Type III may only be used with permission of the SER given in writing.
4. Do not use air-entraining cements.

B. Normal Weight Fine Aggregate: Shall be washed, inert, natural sand conforming to ASTM C33.

C. Normal Weight Coarse Aggregate: Shall be well-graded crushed stone or washed gravel conforming to ASTM C33.

D. Light Weight Fine and Coarse Aggregate: Shall conform to ASTM C330.

E. Water: Shall be from approved source, potable, clean and free from oils, acids, alkali, organic matter and other deleterious material.

F. Admixtures:

1. Normal Range Water-reducing Agent: ASTM C494, Type A. Water-reducing agent shall be by same manufacturer as air-entraining agent.
2. Acceptable Products and Manufacturers:

    a. "Eucon WR-91" by Euclid Chemical Company
    b. "ZYLA610" by W. R. Grace & Co.
    c. “Pozzolith” Series by BASF Corporation
    d. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

3. Mid-Range Water Reducing Agent: ASTM C494, Type A Water-reducing agent shall be by same manufacturer as air-entraining agent.
4. Acceptable Products and Manufacturers:

    a. “Eucon MR” by Euclid Chemical Co.
    b. "MIRA62" by W.R. Grace & Co.
    c. "PolyHeed" Series by BASF Corporation
    d. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

5. High Range Water Reducing Agent / Retarder: ASTM C494, Type F or Type G Water-reducing agent shall be by same manufacturer as air-entraining agent.
6. Acceptable Products and Manufacturers:

a. "Eucon-37 (F)" or "Eucon-537 (G)" by Euclid Chemical Co.
b. "WRDA (F)" or "Daracem-100" by W.R. Grace & Co.
c. "Glenium" Series or "Rheobuild 1000" by BASF Corporation
d. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

7. Air-entraining agent: ASTM C260. In no instance shall air percent content exceed five percent (5%) by volume.
8. Acceptable Products and Manufacturers:

a. "Eucon Air Mix" by Euclid Chemical Co.
b. "Darex AEA" by W. R. Grace & Co.
c. "Micro Air" by BASF Corporation
d. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

2.2 CONCRETE MIXTURES

A. Footings and Foundation Walls: Proportion structural normal weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 PSI at 28 days.
2. Maximum water – cementitious material ratio: 0.45.
3. Slump Limit: 4 in., plus or minus 2 in.
4. Air Content: 6 percent, plus or minus 1 1/2 percent at point of delivery for 3/4 in. nominal maximum aggregate size.

B. Site Concrete including Walls and Site Retaining Walls (all concrete exposed to weather): Proportion structural normal weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 PSI at 28 days.
2. Maximum water – cementitious material ratio: 0.40.
3. Slump Limit: 4 in., plus or minus 1 in.
4. Air Content: 6 percent, plus or minus 1 1/2 percent at point of delivery for 3/4 inch nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion structural normal weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 PSI at 28 days.
2. Maximum water – cementitious material ratio: 0.45.
3. Slump limit: 4 in., plus or minus 1 in.
4. Air Content: 5 percent, plus or minus 1 1/2 percent at point of delivery for 3/4 in. nominal maximum aggregate size. Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Slabs on Steel Deck: Proportion structural normal weight and light weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 PSI at 28 days.
2. Maximum water – cementitious material ratio: 0.45.
3. Slump Limit: 4 in., plus or minus 2 in.
4. Air Content: 5 percent, plus or minus 1 1/2 percent at point of delivery for 3/4 in. nominal maximum aggregate size.

E. Exterior Paving Concrete: Proportion structural normal weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 PSI at 28 days.
2. Maximum water – cementitious material ratio: 0.40.

3. Slump Limit: 4 inches, plus or minus 2 inch.
4. Air Content: minimum 6 percent, plus or minus 1 1/2 percent at point of delivery for 3/4 inch nominal maximum aggregate size.

F. Concrete Fill in Metal Pan Stairs: Proportion structural normal weight concrete mixture with 3/8 in. aggregate as follows:

1. Minimum Compressive Strength: 4,500 PSI at 28 days.
2. Maximum Water – cementitious material ratio: 0.45.
3. Slump limit: 4 inches, plus or minus 2 inch.
4. Air Content: 6 percent, plus or minus 1 1/2 percent at point of delivery.

G. Water reducing and air-entraining agents shall be used in all concrete. Total entrapped air plus entrained air in freshly mixed concrete shall be four percent (Plus or minus one percent) of volume of concrete with required strengths maintained.

1. Use a high range water reducing agent for all concrete for slabs-on-grade and slabs-on-metal deck.
2. Use a mid-range water reducing agent in all pumped concrete with a water/cement ratio greater than 0.40.
3. Use a high range water reducing agent in concrete with a water cement ratio of 0.40 or less.

H. Calculated Equilibrium Unit Weight of dry normal weight concrete shall be 147 pcf, plus or minus 3 lbs. / cu. ft. as determined by ASTM C 567.

I. Calculated Equilibrium Unit Weight of all dry light weight concrete shall be 113 pcf, plus or minus 3 lbs. / cu. ft. as determined by ASTM C 567.

J. In lieu of preparing mix design in laboratory, a production mix may be proposed provided a record of at least 30 consecutive strength tests is submitted to the Architect and SER for review. Tests shall be from similar mix used in last 12 months and average compressive strength shall be consistent with standard deviation of compressive strengths permitted in ACI 318, Chapter 4, paragraph 4.3, "Proportioning on the basis of field experience".

K. Any deviation from approved mix design, which the General Contractor deems desirable under certain project conditions, will not be allowed without examination and written review by the SER.

1. Costs of additional testing by the SER and/or the Testing Agency shall be paid for by the General Contractor, at no additional cost to the Owner.

2.3 FORM MATERIALS

A. Exposed Concrete Surfaces: Shall conform to ACI-301, Chapter 13.

B. Forms for concrete flat surfaces exposed to view in finished work shall be new Class I High Density Overlay Plyform, exterior grade, not less than five ply nor less than 5/8 in. thick conforming to U.S. Product Standard P-1-66.

1. All form joints shall be sealed with approved non-staining sealant to be watertight.

C. Concrete Surfaces Not Exposed to View: Forms for concrete surfaces not exposed to view in finished work shall be made of wood, metal or other materials subject to review of the Architect and the SER, and shall conform to ACI 301, Chapters Four and Ten.

D. Form Ties and Spreaders: Ties for walls in areas exposed to view in finish work.

1. Basis-of-Design Product and Manufacturer: Type SPCH - Stainless Steel "Snap-Ties" by Richmond Screw Anchor Co., or a SER acceptable equivalent subject to compliance with requirements from one of the following manufacturers:
2. Superior Concrete Accessories, Inc.
3. Dayton Sure-Grip and Shore Co.
4. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.
5. Wire ties shall not be used.
6. Where concrete is to be left exposed, painted or plastered, ties shall have removable tapered, plastic cones 1 in. outside diameter.
7. Ties for walls below grade and in areas not exposed to view in finished work shall be snap ties with removable cones, and shall incorporate water seal washer.

E. Form Release Agent: Shall be of a non-staining and non-emulsifiable type, or equal approved by the SER. Form release agent shall not impart any stain to concrete nor interference with adherence of any finish material to be applied to any concrete surface.

2.4 REINFORCEMENT AND ACCESSORIES

A. Recycled Content of Steel: Use maximum available percentage of recycled steel. Reinforcing steel incorporated into the work shall contain not less than 95 percent of recycled scrap steel.

B. Reinforcing Steel Bars: Shall be newly rolled billet steel conforming to ASTM A 615 (Grade 60 unless noted). Bars shall be bent cold as required. Reinforcing bars being welded shall conform to ASTM A 706, Grade 60.

C. Welded Wire Fabric ASTM A 185: All welded wire fabric shall be supplied in sheets and is to be used in slabs on grade and on deck as noted. No fiber mesh substitutes will be permitted.

D. Reinforcement Accessories: Shall conform to Product Standard PS7-766, National Bureau of Standards, Department of Commerce, Class C. Reinforcement accessories shall include spacers, chairs, ties, slab bolsters, slips, chair bars, and other devices for reinforcement.

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
2. Hohmann & Bernard, Inc.
3. Superior Concrete Accessories, Inc.
4. Dayton Sure-Grip and Shore Co.
5. R.K.L. Building Specialties Co., Inc.
6. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.
7. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. Concrete bricks may be used to support reinforcing steel where application allows.

2.5 MISCELLANEOUS MATERIALS

A. Under-slab Vapor Retarder:

1. Non-woven plastic geo-membrane sheet product meeting or exceeding the requirements of an ASTM E-1745 vapor retarder.
2. Performance Requirements:
3. Permeance of less than 0.01 Perms [grains / (ft2 – hr – inHg)] as tested in accordance with ASTM E 1745 Section 7.

4. Other performance criteria:

   a. Strength: Meet ASTM E 1745 Class A requirements.
   b. Tensile Strength: 45 pound-feet / in per ASTM D-882 or E-154
   c. Puncture Resistance: 2200 grams per ASTM D-1709
   d. Thickness: 15 mils. Minimum

5. Manufacturer:

   a. Basis of Design: Stego Wrap Vapor Barrier (15 –mil.) by Stego Industries LLC, (877) 464-7834; www.stegoindustries.com.

6. Other acceptable products:

   1) Perminator (15 mil) by W. R. Meadows, Inc. (800) 342-5976; www.wrmeadows.com.
   2) Barrier-Bac VB-350 (16 mil) by Inteplast Group, (877)535-0555, www.BarrierBac.com.
   3) Vapor Block (15 mil) manufactured by Raven Industries, (800) 635-3456; www.ravenind.com.
   4) Griffolyn (15 mil) manufactured by Reef Industries, (800) 231-6074; www.reefindustries.com.
   5) Viper II (15 mil) manufactured by Insulation Solutions, Inc. www.insulationsolutions.com.
   6) Other manufacturer's products accepted by the Awarding Authority as equal to the specified products. Submit as substitutions: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

7. Accessories:

   a. Seam tape, mastic, piping boots, termination strips and other accessory items as recommended by the manufacturer.

B. Curing Mediums:

1. Absorptive Cover: Burlap cloth made from jute or Kenaf, weighing approximately nine ounces per square yard complying with AASHTO M182, Class 2.
2. Moisture Retaining Cover: One of the following complying with ASTM C171:
3. Waterproof paper,
4. Polyethylene film,
5. Polyethylene-coated burlap.

C. Floor Hardener: Hardener to be used at exposed concrete surfaces where no beddings or adhesive will be applied.

1. Chemical Hardener by Sonneborn Building Products, Inc. / BASF,
2. Construction Chemicals by Building Systems or approved equal.
3. Concrete Floor Hardener by Sweeney Materials, Inc.

D. Non-shrink Cement Grout: Shall be ready-to-use non-metallic aggregate product requiring only addition of water at job site. Grout shall be easily workable and shall have no drying shrinkage at any age. Compressive strength of grout (2 x 2 in. cubes) shall not be less than 5000 psi at seven days and 7500 psi at 28 days.

1. Manufacturer List. Subject to compliance with requirements, provide products by one of the following:
2. W. R. Grace & Co
3. Sonneborn Building Products, Inc. / BASF
4. Sakrete Company
5. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

E. Threaded Inserts and Dowels: Shall be structural concrete insert of type shown on Drawings. Galvanize all components in accordance with ASTM A 153, unless indicated to be stainless steel.

1. Manufacturer List. Subject to compliance with requirements, provide products by one of the following:
2. Hohmann and Barnard, Inc.
3. Richmond Screw Anchor Co.
4. Superior Concrete Accessories Inc.
5. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

F. Waterstops: Provide flat, dumbbell type or center bulb type waterstops at construction joints, or other joints as indicated on the Drawings.

1. Waterstops shall be constructed of thermoplastic in accordance with The Corps of Engineers CRD-C572.
2. Waterstops shall be continuous using splices as recommended by the manufacturer so as to prevent the passing of water through the joint.

G. Preformed Joints: Install as per the manufacturer's instruction the following material to form the control joint at all slabs on grade.

1. Acceptable Products and Manufacturers:
2. Keyed Kold Joint by The Burke Co., San Mateo, California.
3. Kold Seal Zipper Strip by Vinylex Corporation, Knoxville, Tennessee
4. Preformed Control Joints by W. R. Meadows.
5. Substitution Limitations: See Section 01 25 00 – SUBSTITUTION PROCEDURES.

H. Under-slab Rigid Insulation: As specified at Section 07 21 00 – THERMAL INSULATION.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination and Acceptance of Conditions per Section 01 40 00 - QUALITY REQUIREMENTS, and as follows:

1. Carefully examine installation areas with Installer/Applicator present, for compliance with requirements affecting Work performance.
2. Verify that field measurements, substrates, structural support, utility connections, tolerances, levelness, plumbness, humidity, moisture content level, cleanliness and other conditions are as required by each manufacturer, and ready to receive Work.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION OF FORMWORK

A. Use forms for all concrete, including footings, except as otherwise permitted in writing by Architect and/or the SER. Design and construct concrete forms to withstand all forces, including construction live loads imposed upon them during placing and curing of concrete, and with adequate bracing to hold them within specified tolerances for lines and grades shown on Drawings as specified under ACI 347.

B. Before reinforcement is placed on or against formwork, formed surfaces coming in contact with fresh concrete shall be cleaned and then treated with approved form release agent.

C. Before form materials can be re-used, surfaces that will be in contact with freshly cast concrete shall be thoroughly cleaned, damaged areas repaired and projecting nails withdrawn. Re-use of form material shall be subject to review by the Architect and/or the SER.

D. Tolerances for formed surfaces: Produce formed concrete work to the dimensions shown on the Drawings within the tolerances given in ACI 347.78, Article 3.31. The tolerances are the maximum allowable dimensional departure from the planes and points established by the Drawings, subject to the maximum rate of change in plane equal to the tolerance dimension and distance first stated in Article 3.3.l for each category of work.

E. Tolerances for Architecturally exposed concrete formed surfaces: Surfaces permanently exposed to view shall be considered “Class A” finish, with no abrupt or gradual surface irregularity in excess of 1/8 inch within a 5 foot measured dimension.

1. Abrupt irregularities are defined to include offsets and fins resulting from displaced, mismatched or misplaced forms, surface defects in form materials, sheathing or liners, and voids within concrete due to improper vibrating.
2. Gradual irregularities are defined to include those resulting from warping, deflection or bending of formwork or similar variations from planeness. Gradual irregularities will be measured with a straightedge for flat surfaces.
3. Rejection of Exposed Formed Concrete: Any Architectural Concrete that does not conform to the requirements of ACI 347, Article 5.2 for appearance and quality or the requirements stated herein, when forms are removed, is subject to rejection by the Architect and/or the SER. Rejected work shall be removed and replaced at the General Contractor's expense.

3.3 PLACING OF REINFORCEMENT

A. Reinforcement shall be placed in accordance with requirements of CRSI (MSP) "Placing Reinforcing Bars" and with further requirements below.

B. Heating, bending, tack welding, curing or substituting reinforcement in field is prohibited, other than as shown on Drawings.

C. Reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings.

D. Reinforcement shall be spliced only in accordance with requirements of Contract Documents. Splices of reinforcement at points of maximum stress shall generally be avoided. Welded wire fabric shall lap 12 in. or two spaces, whichever is larger, and shall be wired together.

3.4 VERTICAL JOINTS

A. Construction and control joints indicated on Drawings are mandatory and shall not be omitted.

B. Construction joints shall be continuously bevel keyed, 2 x 4 in. nominal, except as noted, and first placed surface shall be treated as specified under "Placing Concrete" in this Section.

C. Joints not indicated or specified shall be placed to least impair strength of structure and shall be subjected to review of the SER.

3.5 INSTALLATION OF EMBEDDED ITEMS

A. Conform to requirements of ACI 318, Chapter 6, paragraph 6.3, "Conduits and Pipes Embedded in Concrete", and as specified below.

B. Installation of inserts required by other trades, shall be coordinated with, or shall be installed prior to, placing of reinforcing steel. All inserts shall be supplied by respective trades and installed by the General Contractor.

3.6 INSTALLATION OF UNDER-SLAB VAPOR RETARDERS OR BARRIERS AND INSULATION

A. Install insulation in conformance with the manufacturer's printed instructions specific to the application, accepted shop drawings, and Section 07 21 00 – THERMAL INSULATION.

B. Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

C. Install vapor retarder or barrier in conformance with manufacturer's printed instructions and these specifications.

1. Overlap edges of sheets 6 in. and tape joints using manufacturer's sealing tape.
2. Seal all penetrations by piping, conduits, rebar or other penetrant items with manufacturer's mastic and/or sealing tape.
3. Seal vapor barrier sheet to surrounding vertical surfaces as shown on Drawings.
4. Protect installed vapor retarder from damage and perforation following installation. Sequence installation so that sheet will not be exposed to traffic without protection for extended periods of time.
5. Prior to concealing vapor barrier, notify the Architect to arrange for evaluation of the in-place material for damage including perforations.
6. Repair all damaged areas per the manufacturer's recommendations, or replace products if repair is not acceptable, as identified by the Architect.

3.7 SLAB ON GRADE JOINTS

A. Control joints in the slab on grade shall be made by either of the following methods:

1. Saw Cutting: Saw cutting shall be accomplished using a "Soff-Cutt" saw or approved equal.
2. Saw cutting shall begin immediately after final finishing.
3. Where saw cut joints may read through floor finishes, fill joint with grout prior to installing proposed finish.
4. When slab curl occurs at saw-cut joints that will be visible through floor finishes or is unacceptable to the manufacturer or installer of applied finishes, grind, fill or repair slabs per corrective work requirements of this section.
5. Preformed Joints: Install as per the manufacturers instruction material to form the control joint at all slabs on grade.

3.8 MIXING, CONSISTENCY, AND DELIVERY OF CONCRETE

A. Concrete shall be ready-mixed and produced by a plant acceptable to the SER and the Testing Agency. Hand or site mixing shall not be done. Constituents, including mixture, shall be batched at the central batch plant. Admixtures shall be premixed in a solution form and dispensed as recommended by the manufacturer.

B. Concrete shall arrive at the job site at a slump of 2 – 3 in., and at the time of deposit shall be as follows:

1. Portion of Structure, Slump, Recommended Max. Range

   a. Pavements, Slabs on Grade and Metal Decks, 4 inch, 3 - 5 inch
   b. Footings, Grade Beams, Pile Caps, 4 inch, 3 - 5 inch
   c. Site Concrete and Site Retaining Walls, 4 inch, 2 - 6 inch
   d. Reinforced Walls, 4 inch, 2 - 6 inch
   e. Metal Pan Stairs, 3 inch, 1 – 3 inch

2. If a high range water reducing admixture (super-plasticizer) is used, it may be added at the job site after verifying that the delivery slump is 2 to 3 in. The maximum slump, after adding the HRWR admixture, shall be 8 in.
3. For normal weight concrete, water may be added to the concrete at the site only to make up water withheld at the plant. Batching plant shall document on the driver's delivery ticket any water withheld at the plant. When water has not been withheld and slump is too low for proper handling of concrete, use the HRWR admixture to bring slump within specified range.

C. Ready-mix concrete shall be transported to site in watertight agitator or mixer trucks loaded not in excess of rated capacities.

1. Discharge at site shall be within one and one-half hours after cement was first introduced into mix.
2. When air temperature is between 85 to 90 deg F, discharge at site shall be within 75 minutes and when air temperature is above 90 deg F, discharge site shall be within 60 minutes.
3. Concrete with a temperature greater than 90 deg F shall not be placed.
4. Central mixed concrete shall be plant mixed a minimum of five minutes.

D. Re-tempering of concrete that has partially hardened, that is, mixing with or without additional cement, aggregates, or water, will not be permitted.

3.9 PLACING CONCRETE

A. Remove water and foreign matter from forms and excavations. Except in freezing weather or as otherwise directed, thoroughly wet wood forms just prior to placing concrete. Place no concrete on frozen soil, ice or standing water, and provide adequate protection against frost action during freezing weather.

B. Soil bottom for slabs and footings, reinforcing, inserts, and forms shall be reviewed by Architect or his designate and/or the SER before placing concrete.

C. To secure full bond at construction joints, surfaces of concrete already placed, including vertical and inclined surfaces, shall be thoroughly cleaned of foreign materials and laitance, roughened with suitable tools such as chipping hammers or wire brushed, and re-cleaned by stream of water or compressed air.

1. Well before new concrete is deposited, joints shall be saturated with water.

2. After free or glistening water disappears, joints shall be given thorough coating of neat cement slurry mixed to consistency of very heavy paste.
3. Surface shall receive coating of at least 1/8 in. thick; this shall be scrubbed in by means of stiff bristly brushes.
4. New concrete shall be deposited before neat cement dries.

D. Do not place concrete having a slump outside of allowable slump range.

E. Transport concrete from mixer to place of final deposit as rapidly as practical by methods which prevent separation of ingredients and displacement of reinforcement and which void re-handling. Deposit no partially hardened concrete. When concrete is conveyed by chutes, equipment shall be of such size and U-shaped design as to insure continuous flow in chute. Flat (coat) chutes shall not be employed.

F. During and immediately after depositing, concrete shall be thoroughly consolidated by means of internal type mechanical vibrators.

G. Vertical lifts shall not exceed 18 in. Vibrate through successive lifts to avoid pour lines. Vibrate first lift thoroughly until top of lift glistens to avoid stone packets, honeycomb, and segregation.

H. Concrete shall be deposited continuously and in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams and planes of weakness within section.

1. If section cannot be placed continuously between planned construction joints, as specified, field joint and additional reinforcement shall be introduced so as to preserve structural continuity.
2. Notify Architect and/or the SER of each such case.

I. Cold Weather Placement – comply with ACI 306.1 and as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing conditions or low temperatures.
2. Follow ACI cold weather placement procedures when concrete is placed at or below an ambient air temperature of 40 deg F; or, whenever, in the opinion of the National Weather Service five-day weather forecast, the temperatures are likely to be below 40 deg F within 24 hours after placement of concrete. Maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
5. Do not use calcium chloride, salt or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

J. Hot Weather Placement – Comply with ACI 305 and as follows:

1. Maintain concrete temperature below 90 degrees Fahrenheit at time of placement. Chilling 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 the General Contractor's option.
2. Fog-spray forms, steel reinforcement and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots or dry areas.

K. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of the construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
6. During placement of concrete on slabs-on-deck, do not pile concrete. Place concrete uniformly to prevent excessive deflection of the deck and the beams.

3.10 FINISHING OF UNFORMED CONCRETE SURFACES

A. Required concrete finishes shall conform to ACI 301 and ACI 302 as follows:

1. Concrete slabs-on-grade shall be finished with floor flatness and levelness tolerances in accordance with ACI 302-8.15 with an Ff = 35 for Specified Overall Value (SOV) and Ff = 25 for Minimum Local Value (MLV) and Fl = 25 for Specified Overall Value (SOV) and Fl = 20 for Minimum Local Value (MLV).
2. Concrete slab-on-deck shall be finished with floor flatness tolerances in accordance with ACI 302-8.15 with an Ff=30 minimum.
3. When another finish is to be added or applied to a concrete slab, refer to the manufacturer and sub-contractor for required floor flatness, levelness, and/or tolerance. If these requirements are different from those specified, the more stringent requirements shall apply.

B. Scratched Finish: Shall be provided on concrete slabs, which required bond for subsequent topping, or second slab cast over the first. Location: (see Drawings) Method: per ACI 301-5.3.4.2a (steel rakes).

C. Steel Trowelled Finish - Location: All interior slabs, tops of equipment pads. Method: Per ACI 301-5.3.4.2c.

D. Floated Finish: Location - All depressed slabs receiving another finish. Method: Per ACI 301-5.3.4.2b.

1. Light Broom Finish: Location – entrance frost pads.

3.11 CURING AND PROTECTION

A. When concrete is placed at or below an ambient air temperature of 40 deg F, or, whenever, in the opinion of the National Weather Service five-day weather forecast, the temperatures are likely to be below 40 deg F within 24 hours after placement of concrete, cold weather concreting procedures, according to ACI 306 and as specified herein, shall be followed.

1. To this end, the entire area affected shall be protected by adequate housing or covering and heating.
2. No salt, chemicals, or other foreign materials shall be used in mix to lower freezing point of concrete.

B. Protect concrete work against injury from heat, cold, and defacement of any nature during construction operations.

C. Concrete shall be treated immediately after concreting or cement finishing is completed, to provide continuous moist curing above 50 deg F for at least six days, regardless of ambient air temperatures, unless noted otherwise.

D. Keep permanent temperature record, showing date and outside temperature for concreting operations.

1. Thermometer readings shall be taken at start of work in morning, at noon, and again late in afternoon. Locations of concrete placed during such period shall likewise be recorded, in such manner as to show any affect temperatures may have had on construction.
2. Copies of record shall be distributed daily to the SER and the Testing Agency.

E. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
3. In order to avoid plastic or drying shrinkage cracks during warm, dry or windy weather, ACI 302 and ACI 309 shall be followed using wind breaks and sun shades when recommended. Evaporation retardant shall be as specified in Part 2 above.

F. Curing Methods – Provide moisture cover curing as follows:

1. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.12 REMOVING FORMWORK

A. The General Contractor shall be responsible for proper removal of formwork.

B. Forms shall be removed only after concrete has attained 40 percent of the specified 28 day design strength. Construction loads and lateral loads should be placed without damage to the structure or cause any excessive deflection.

3.13 FINISHING OF ARCHITECTURALLY EXPOSED FORMED CONCRETE

A. Concrete that will be exposed in the completed work shall receive smooth form finish conforming to ACI 301, and sandblast treatment.

1. Apply sandblasted finish to exposed concrete surfaces at least 72 hours after placement of concrete. Coordinate with concrete placement schedule and formwork removal to ensure that surfaces to be blast finished are blasted at the same age for uniform results.
2. Use an abrasive grit of proper type and gradation to provide brush sandblast finish – do not expose aggregates.
3. Perform sand blast finishing in as continuous an operation as possible utilizing the same work crew to maintain continuity of finish on each surface or within each area.

3.14 FIELD QUALITY CONTROL

A. Field Tests and Inspections per Section 01 40 00 – QUALITY REQUIREMENTS, and as follows:

1. A Program of Inspection and Testing of cast-in-place concrete work will be established by the Structural Engineer of Record (SER) who will direct the implementation of tests as carried out by an independent Testing Agency, under a separate contract with the Owner.
2. Materials and workmanship shall be subjected to inspection and testing in mill, shop, and/or field by the SER and/or the Testing Agency.
3. Such inspection and testing shall not relieve the General 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.
4. General Contractor shall notify the SER and the Testing Agency prior to start of any phase of concrete work so as to afford them reasonable opportunity to inspect work. Such notification shall be made at least 24 hours in advance.
5. Compression tests shall consist of one set of five cylinders for each test made, cured, and tested by the Testing Agency during progress of job as a minimum. One cylinder will be tested at seven days and three cylinders will be tested at 28 days. One cylinder shall be retained to be tested at 56 days if the 28 day results are not acceptable and this cylinder may be discarded if not tested. One set of cylinders shall be taken for every 50-cubic yards of concrete or fraction thereof and furthermore shall be taken from batch with highest slump.
6. Material and/or workmanship that is rejected by the SER and/or the Testing Agency either at the plant or at the job site shall be replaced promptly by the General Contractor to the satisfaction of the SER at no expense to the Owner.

B. General Contractor shall hire a testing agency to prepare and test concrete cylinders, as required, for their use and certification of foundations prior to steel erection.

C. Non-Conforming Work per General and Supplementary Conditions, and as follows: Remove, Repair and Reinstall or Restore in Place damaged items prior to inspection for Substantial Completion.

1. Finish touch-up damaged surfaces.
2. Replace damaged materials or items with new if repair not acceptable to Architect.

D. Manufacturer Services per Section 01 40 00 – QUALITY REQUIREMENTS, and as follows: Manufacturer's or Fabricators' field representative(s) shall give product use recommendations, and perform site visits to inspect product installation in accordance with instructions and warranty requirements.

E. Test and Evaluation Reports - submit to the Architect and SER:

1. Batching and mixing procedure report.
2. Copies of concrete placement temperature records.

3.15 CORRECTIVE WORK AND CRACK SEALING

A. Provide crack sealing for exposed concrete surfaces that develop cracks beginning at placement and through the one year correction period beginning on the date of Final Completion.

1. Seal material shall be non-staining and resilient, matching the concrete color.
2. Corrective work on defects and crack seal shall be performed subject to review of the Architect and/or the SER.
3. Corrective work and crack sealing shall include all required labor, materials, and equipment.

3.16 CLEANING AND PROTECTION

A. Comply with requirements of Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

B. Concrete surfaces shall be cleaned of all form release agent stains in one complete operation in the manner indicated by the manufacturer and reviewed by the Architect and/or SER.

1. Caution to be exercised to avoid staining from work overhead.
2. Concrete cleaning shall commence when concrete is at least 28 days old, unless otherwise directed by Architect and/or SER.

C. Protect concrete slab surfaces scheduled to be exposed in finished spaces, including slabs indicated to be polished immediately after curing.

1. Do not permit the following activities to take above concrete surfaces to be polished:
2. ANY type of storage within 28 days of concrete placement.
3. Vehicle parking
4. Pipe cutting operations
5. Ferrous metals storage

D. Protect installed work from construction operations until date of Final Completion or Owner occupancy, whichever occurs first.

END OF SECTION

SECTION 033300

ARCHITECTURAL CONCRETE

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-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
2. The requirements of this Section complement Section 033000, CAST-IN-PLACE CONCRETE; and apply to architectural concrete as specified and as indicated on Drawings.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 033000 - CAST-IN-PLACE CONCRETE for formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
2. Section 079200 - JOINT SEALANTS for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Description of Methods and Sequence of Placement. For each type of specially-finished concrete provide description of methods and sequence of placement.

C. Certificates: Prior to installation submit copies of a signed affidavit from the manufacturer of the coloring product stating that coloring product to be used in concrete is compatible with the concrete mix and type to which it will be combined, and that no adverse affects will occur to the workability, setting, or strength of concrete.

D. Manufacturer's Review: Submit written signed statement, that Contract Documents have been reviewed by qualified representatives of the materials manufacturer, and that materials and system to be used for floor finish are proper and adequate for the applications shown.

E. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for all products in concrete floor finish, including certifications and other data as may be required to show compliance with the Contract Documents.

F. Substrate Acceptability: Submit a certified statement issued by the manufacturer of concrete floor finish materials and countersigned by installer, attesting that surfaces designated to receive concrete floor finish are satisfactory warranty requirements. Application of materials will be construed as acceptance of surfaces.

G. Statement of Supervision: Submit signed statement signed that field supervision by manufacturer's representative was sufficient to ensure proper application of materials and that the installation is acceptable to manufacturer.

H. Samples for Verification: Architectural concrete samples, cast vertically, approximately 18 by 18 by 2 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.5 QUALITY ASSURANCE

A. Finish Objective Samples. If samples are placed on display in the office of the Architect, to describe finish objectives, such samples are hereby made part of these Specifications to the degree that the samples exhibit the required color, texture and surface finish requirements. Such samples, if provided, are provided for bidding purposes only; the actual mix components, forming, placing, and finishing procedures and requirements shall be as determined by acceptable preconstruction mock-ups.

B. Preconstruction Conference. Attend a preconstruction conference prior to the start of architectural concrete construction as directed by the Architect. Discussion will include the following:

1. The Contractor's program to obtain the specified quality of architectural concrete.
2. The procedures and methods for construction of preconstruction mock-ups specified herein.

C. Preconstruction Mock-up Panels or Areas:

1. General:

a. Schedule mock-up casting for acceptance 30 days prior to casting of architectural concrete surfaces represented by the mock-ups.
b. Locate mock-up panels in non-public areas acceptable to the Architect. Brace panels as required for safety.
c. Continue to cast mock-ups until acceptable mock-ups are produced. Accepted mock-ups shall be the standard for color, texture, and workmanship for the work.
d. Mock-up sequence of forming, placing, form removal, curing and finishing shall be reviewed and accepted by the Architect.

e. Mock-up formwork shall be inspected and accepted by the Architect before placing of concrete.
f. Use the same concrete mixes and placement procedures, accepted in mock-ups, in the final work, unless otherwise directed by the Architect.
g. Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-up.
h. Remove mock-up panels from site at completion of Project, as directed by the Architect.

2. Construct mock-up panels or areas as indicated to demonstrate the ability to cast architectural concrete to achieve shapes, color, and textured finishes required. Mock-ups shall include or meet the following requirements:

a. Provide full scale mock-up panels and areas.
b. Provide mock-ups simulating actual design and execution conditions for concrete mix materials, reinforcement, formwork, placing sequence, form removal, curing, finishing, and methods and materials of stain removal and correction of defective work.
c. On mock-ups where directed by the Architect, provide minimum of five variation of mix color to be used in the repair of defective work, in order to determine acceptable color and texture match.
d. Demonstrate, on the mock-ups, materials and methods of plugging tie-holes unless tie holes are indicated to be left in place.
e. Demonstrate in the construction of the mock-up formwork the sealer material, form release agent, and curing materials and methods to be used.

D. Source of Materials. Utilize the same source, stock or brand of concrete materials for each class or mix of architectural concrete. Do not interchange materials or mixes until an additional mock-up shows that uniformity in finish, texture, and color, as compared to original mock-up will be maintained. If necessary, obtain and stockpile materials in sufficient quantity to ensure continuity and uniformity.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's unopened containers identified with brand, type, grade, date of manufacture, class, lot number, and other qualifying information.

B. Store materials in original sealed containers, in dry enclosed storage area, within temperature range recommended by manufacturer.

1.7 JOB CONDITIONS

A. Maintain manufacturer's current installation instructions at Project site.

B. Maintain interior building area above 50 degrees F. before, during, and after installation of architectural concrete until structure and subfloor temperatures are stabilized.

C. Provide and maintain adequate ventilation until concrete cures completely.

1.8 PROTECTION

A. Protect adjacent surfaces and repair, restore, or replace soiled or damaged in performance of special architectural concrete finish work.

1.9 GUARANTEE

A. Warrant work of this Section for five years from date of Substantial Completion; correct defects upon written notice at no additional cost to Owner. Warranty shall be signed by installer and materials manufacturer.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Except as otherwise indicated, concrete materials including aggregates, Portland cement, and water shall conform to Section 033000, CAST-IN-PLACE CONCRETE.

2.2 ARCHITECTURAL CONCRETE FOR VERTICAL WALLS

A. Concrete: Color of concrete shall be normalweight concrete without color additive; color for architectural concrete shall be uniform throughout area designated.

B. Formwork Ties: Formwork tie spacing and location of ties shall be in a consistent pattern or layout acceptable to the Architect. Tie design shall be acceptable to the Architect.

C. Formwork Materials: Steel faced or fiberglass faced formwork as required to produce a smooth form finish acceptable to the Architect.

1. Architectural Concrete Finish No. 1 - Smooth Form Finish with Smooth Rubbed Finish:

a. Formwork: Smooth form concrete using steel forms or fiberglass forms. Joints in formwork shall be sealed. Form ties shall be uniformly placed accurately located in accordance with layout approved by the Architect.
b. Finish Description/Procedure: Rubbing shall be produced on newly hardened concrete no later than the day following form removal. When required by the Architect to correct work done in an incorrect manner or in a manner not as specified, rubbing shall commence within 48 hours of notification by the Architect. Surfaces to be rubbed shall be wetted and rubbed with carborundum brick or other approved abrasive of equal quality until uniform color and texture are produced, without applying any cement, grout or other coating. Rubbing will not be permitted when the air temperature is expected to fall below 40 degrees F. Rubbing may be performed by use of approved power equipment and tools, providing that the operational procedures shall produce the same desired effects as hand rubbing.
c. Cement Color: Color meeting approved mock-up. In order to achieve the desired color/finish of concrete, concrete mix may required the use of a white cement or control of color of aggregates may be required.

PART 3 - EXECUTION

3.1 PLACING CONCRETE

A. Except as modified herein, concrete shall be placed in accordance with Section 033000, CAST-IN-PLACE CONCRETE.

1. Consolidate vertical colored concrete in lifts 1 ft. or less in depth and vibrate twice that normally required by decreasing the spacing, depth, and time to ensure uniform color.

2. There shall be no honeycombing or segregated aggregates in concrete exposed to view in areas identified as Architectural Concrete.

3.2 PROTECTION FROM AND REMOVAL OF STAINS

A. On mock-up where directed by the Architect, demonstrate methods of rust stain removal in accordance with recommendations of ACI 303 Chapter 10, Section 10.4.

B. Comply with requirements of Section 033000, CAST-IN-PLACE CONCRETE, and procedures used in construction of accepted mock-ups.

END OF SECTION

SECTION 034100

CONCRETE REPAIR

(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. Repair of spalled, damaged, cracked and deteriorated concrete, at areas where existing construction is to be removed as identified on the Drawings.
   a. Removal of deteriorated concrete and subsequent patching to match existing adjacent concrete surfaces.
   b. Steel reinforcement.
   c. Crack repair.

1.3 SUBMITTALS

A. Product Data: Include material descriptions, cut sheets, chemical composition, physical properties, test data, and mixing and application instructions.

B. Samples for Verification: Before erecting mockups, submit representative samples of cured materials for visual approval.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type or repair material from a single manufacturer.

B. Mockups: Prepare mockups of restoration and cleaning 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. Remove and replace mock-ups which are not approved by Architect.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

B. Store cementitious materials off the ground, under cover, and in a dry location.

C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.6 PROJECT CONDITIONS

A. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F and above.

B. 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.

C. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer. Minumum application temperature 40 F.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable, clean and free from injurious amount of oil, alkali, organic matter or other deleterious material.

B. Hot Water: Heat water to a temperature of 140 to 160 deg F.

2.2 BONDING AGENT AND REINFORCEMENT PROTECTION

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

B. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. BASF Constrution Chemicals - Building Systems; Emaco P24.
2. Euclid Chemical Company (The), an RPM company; Duralprep A.C.
3. Kaufman Products, Inc.; Surepoxy HM EPL.
4. Sika Corp., Armatec 110 EpoCem.
5. Sto Corp., Concrete Restoration Division; Sto Bonding and Anti-Corrosion Agent.

C. Materials:

1. Basis-of-Design: Sika Armatec 110 EpoCem, as manufactured by Sika Corporation
2. Epoxy resin/portland cement adhesive shall be Sika Armatec 110 EpoCem, or equal.

   a. 3-component solvent-free, moisture-tolerant, epoxy-modified, cementitious product specifically formulated as a bonding agent and an anti-corrosion coating

D. Performance Criteria:

1. Properties of the mixed epoxy resin/portland cement adhesive.

   a. Pot Life: 90 minutes @ 73' F
   b. Contact Time:

95 F	(35 C)	6 hours
68 F	(20 C)	12 hours
50 F	(10 C)	16 hours
40 F	(5 C)	24 hours

2. Properties of the cured epoxy resin/portland cement adhesive.

   a. Compressive Strength (ASTM C-109)

      1) 3 day: 4500 psi (31.0 MPa)
      2) 7 day: 6500 psi (44.8 MPa)
      3) 28 day: 8500 psi (58.6 MPa)

   b. Splitting Tensile Strength (ASTM C-496): 28 days: 600 psi (4.1 MPa)
   c. Flexural Strength (ASTM C-348) at 28 days: 1250 psi (8.6 MPa)
   d. Bond Strength ASTM C-882 at 14 days

      1) Wet on Wet, 0-hr. open time: 2800 psi (19.3 MPa)
      2) 24-hr. open time: 2600 psi (17.9 MPa)

   e. Bond of Steel Reinforcement to Concrete (Pullout Test).

      1) Sika Armatec 110 coated 625 psi (4.3 MPa)
      2) Epoxy coated 508 psi (3.5 MPa)
      3) Plain Reinforcement 573 psi (3.95 MPa)

   f. The epoxy resin/portland cement adhesive shall not produce a vapor barrier.
   g. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the Federal Highway Administration Program Report No. FHWA/RD86/193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

E. Note: Tests above were performed with material and curing conditions at 73F and 50% relative humidity.

2.3 PATCHING MORTAR

A. Patching Mortar, General:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.

2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.
3. Coarse Aggregate for Patching Mortar: ASTM C 33, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. Cementitious Patching Mortar for Vertical Repairs: Packaged, dry mix for repair of concrete, approved by manufacturer for use with bonding agent.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Construction Chemicals.
b. Euclid Chemical Company (The), an RPM company.
c. Kaufman Products, Inc.
d. Sika Corporation:
1) Basis-of-Design: SikaQuick VOH.
e. Sto Corp., Concrete Restoration Division.

2. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.

C. Cementitious Patching Mortar for Horizontal Repairs: Packaged, dry mix for repair of concrete, approved by manufacturer for use with bonding agent.

1. SikaQuick 1000 or equal.

2.4 REINFORCING VERTICAL REPAIRS

A. Provide stainless steel pins as recommended by manufacturer of patching mortar and as required.

2.5 MINOR CRACK REPAIR

A. Epoxy Crack-Injection Adhesive: ASTM C 881/C 881M, Type I, or Type IV, free of VOCs

B. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. BASF Construction Chemicals.
2. Euclid Chemical Company (The), an RPM company.
3. Kaufman Products, Inc.
4. Sika Corporation.

a. Basis-of-Design: Sikadur 35, Hi-Mod LV

5. Sto Corp., Concrete Restoration Division.

C. Performance Criteria:

1. Properties of the mixed epoxy resin adhesive binder:

a. Pot Life: 20-30 minutes

b. Tack-Free Time to Touch (3-5mils) Neat (40F: 14-16 hours, 73F: 3-3.5 hours)
c. Viscosity 375 cps
d. Color: clear, amber.

D. Pre Crack-Injection Epoxy Gel:

1. Sika Corporation.
   a. Basis-of-Design: Sikadur 31 Hi-Mod Gel.
   b. Or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Preparation for Removal of Deteriorated Concrete: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.

B. Protect persons, motor vehicles, equipment, surrounding construction, Project site, plants, and surrounding buildings from injury resulting from concrete rehabilitation work.

1. Protect adjacent equipment and surfaces by covering them with heavy polyethylene film and waterproof masking tape or a liquid strippable masking agent. If practical, remove items, store, and reinstall after potentially damaging operations are complete.

3.2 MIXING AND APPLICATION

A. General: Comply with manufacturer's written instructions and recommendations for application of products, including surface preparation.

B. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to concrete and reinforcing bars, where exposed, by stiff brush or hopper spray according to manufacturer's written instructions. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar or concrete.

C. Placing Patching Mortar: Place as follows unless otherwise recommended in writing by manufacturer:

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.
3. Pretreatment: Apply specified bonding agent.
4. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
5. Patching Thickness: Place material in lifts in accordance with manufacturer’s recommendations. Do not feather edge.
6.
7. Consolidation: After each lift is placed, consolidate material and screed surface.

8. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
9. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a surface matching adjacent concrete.
10. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

D. Epoxy Crack Injection:

1. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond, and clean cracks with oil-free compressed air or low-pressure water to remove loose particles.
2. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.
3. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least 1/4 inch (6 mm) thick by 1 inch (25 mm) wider than crack.
4. Inject cracks wider than 0.003 inch (0.075 mm) to a depth of 8 inches (200 mm).
5. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.
6. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.3 CLEANING

A. Examination: Examine all surfaces scheduled for cleaning, for roughness, contaminants, unsound structural substrates, or other conditions that may impair the application. Notify the Engineer in writing of any such conditions; do not continue work until directed by Architect on how to proceed.

1. Monitor weather prior to work to ensure that air temperatures remain between 50°F and 85°F, or as recommended by the manufacturer of chemical compounds and proprietors of cleaning methods.
2. Ensure that building components not to be cleaned, adjacent persons, property, and plant life are protected from all cleaning activities and wind drift. Test adjacent non-masonry materials for reaction with cleaning materials. Mask all windows, ornamental fixtures, hardware, wood doors, or other non-masonry surfaces.

B. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Do not use wire brushes or brushes that are not resistant to cleaner being used. Do not use plastic-bristle brushes if natural-fiber brushes will resist chemical cleaner being used.
2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.
    a. Equip units with pressure gages.
    b. Provide spray applications as follows:
        1) Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
        2) Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.

3. For water spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
4. For heated water spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.

D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

E. Removing Plant Growth: Completely remove plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil and debris from open masonry joints to whatever depth they occur.

F. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to cleaning methods being used. Extraneous substances include paint, calking, asphalt, and tar.

G. Water Application Methods:

1. Water Soak Application, for Stone: Soak stone surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
2. Spray Applications, for Brick and Stone: Unless otherwise indicated, hold spray nozzle at least 6 inches from surface of stone and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

H. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical cleaner manufacturer's written instructions; use brush or spray application methods, at Contractor's option. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.

I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse, if necessary, to produce tested pH of between 6.7 and 7.5.

J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

K. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

SECTION 03 41 13

PRECAST AND PRESTRESSED CONCRETE PLANK

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Carefully review and examine all other Contract Documents for requirements therein affecting the work of this Section. Furthermore, coordinate and sequence the work of this Section with all other trades affected.

1.2 SCOPE OF WORK

A. Work under this Section shall include all labor materials, services and equipment and accessories necessary to furnish and install Precast Plank, complete, as indicated on the Drawings and/or as required by the Specifications, which without limiting the generality thereof include the following:

1. Precast Plank, Fillers, End Stops, and Weld Plates.
2. Grouting of plank.

1.3 RELATED WORK

A. The following related work shall be performed under the designated Sections:

1. Section 01 45 23 – TESTING AND INSPECTING SERVICES.
2. Division 01 Section “PRODUCT REQUIREMENTS”: Listing of VOC requirements for adhesives, cleaning/maintenance materials, paints, coatings and sealants.
3. Division 01 Section “CONSTRUCTION WASTE MANAGEMENT”: procedural and administrative requirement
4. Division 03 Section “CAST-IN-PLACE CONCRETE”
5. Division 05 Section “STRUCTURAL STEEL FRAMING”
6. Division 05 Section “MISCELLANEOUS METALS”: Anchors, Shims and accessories.
7. Section 07 92 00 - JOINT SEALANTS

1.4 SUBMITTALS

A. Shop Drawings for Precast and Prestressed Concrete Plank shall include the name of the manufacturer and all physical properties.

1. Show complete plank layout including all openings to be cast into slab lengths, anchorage details, and all information necessary for the complete installation of this work. Coordinate all openings in planks with the contract drawings. Submit calculations and propose details for any openings that are made in the plank in the field. No openings can be made in the plank in the field without prior approval of the Structural Engineer of Record (SER).
2. Plank shall be laid out and anchored as shown on the structural drawings. Any proposed changes shall be brought to the attention of the Architect. Plank tolerance as required on structural drawing shall be maintained.

B. Submit calculations, stamped by a registered Professional Engineer in the Commonwealth of Massachusetts, indicating all reinforcing necessary to support all design live loads and dead loads including partition loads as shown on the structural and architectural drawings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's instructions for handling and transporting.

B. Lift members at designated points only, and use lifting inserts if provided.

C. Do not place members in positions that will cause overstress, warp, or twist.

D. Handle members to protect from dirt and damage.

E. Place stored members so that identification marks are discernible.

F. Separate stacked members by battens across full width of each bearing point.

G. Stack members so that lifting devices are accessible and undamaged.

H. Store plank so that no water can enter voids in plank.

1.6 QUALITY ASSURANCE

A. Codes & Standards: The latest edition of the following specifications, standards, and codes shall govern with modifications as specified herein.

1. American Concrete Institute, ACI 318 Building Code Requirements for Reinforced Concrete.
2. Prestressed Concrete Institute MNL, 118 Manual for Inspection of Prestressed Concrete, MNL - 116 Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: Portland Cement (ASTM C-150) High early strength Portland Cement (Type III).

B. Aggregates: Conform to specifications for concrete aggregates (ASTM C-330).

C. Water: Water shall be clean, potable fresh, free from acids, alkalies, oils, organic materials and shall be from public mains.

D. Air Entraining Admixtures: Conform to ASTM C-2600. All concrete in this section shall have 3-5% air entrainment. Admixtures shall be allowed in concrete provided they are chemically compatible with all other admixtures used.

E. Calcium Chloride: Do not use calcium chloride in work of this section.

F. Concrete shall have a minimum strength of 5,000 p.s.i. at 28 days and a strength of 3,500 p.s.i. at time of strand release.

G. Prestressed Steel: Prestressed steel shall be high tensile strength uncoated seven wire strand which has been stress relieved as a unit after the wires have been formed into a strand. It shall be manufactured and tested in accordance with ASTM A-416. Grade 250 K or 270K strand may be used.

H. Reinforcing Bars: All reinforcing bars shall conform to the requirements of ASTM A-615. Grade 40 or 60 as required.

I. Welded Wire Fabric: Welded wire fabric shall conform to the requirements of ASTM A-185.

J. Bearing Pads: Pads shall be multipolymer plastic bearing strip unless otherwise noted and shall be supplied and installed based on approval of manufacturer by the Architect.

K. Grout: Grout shall consist of one part Portland Cement to three parts of clean mason sand.

2.2 MIXES

A. Concrete Mix - Manufacturer's standard resulting in a minimum compressive strength at time of initial prestress of 3.500 psi and 5,000 psi at 28 days and slump 4 in. + 1 in..

2.3 FABRICATION

A. Formwork:

1. Construct forms to withstand tensioning and detensioning operations.
2. Construct forms to maintain units within specified tolerances with radius or chamfer at corners.

B. Pretension tendons by single strand tensioning method.

C. Consolidate placed concrete by external vibration without dislocation or damage to reinforcement and built-in items.

D. Provide permanent markings in units to identify pick-up points and location in structure.

E. Detensioning:

1. Delay detensioning of prestressed units until corresponding concrete test cylinder has attained 60 percent of ultimate compressive strength.
2. Perform detensioning while concrete is still warm and moist.
3. Detension pretensioned tendons by saw cutting tendons in sequence and pattern to prevent shock or unbalanced loading.

F. Finishes:

1. Unexposed areas: As cast.
2. Top surface: Roughened finish. Underside: Steel form.
3. Remove irregularities, fins, and other projections.
4. Prime exposed carbon steel anchors.

2.4 CONDITIONS OF SURFACES

A. Prior to the work of this Section, inspect all areas for conformance to requirements for installation of precast units. Notify Contractor, in writing, of any conditions that would adversely affect installation. Do not proceed with work until these conditions have been satisfactorily remedied.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation of plank, check cores for any standing water and remove same.

B. Coordinate with all other trades to permit insertion of any anchors, hangers, or other work required to be set in conjunction with precast prestressed slabs.

C. Do not do any field cutting of slabs, except for adjusting length or levels, under this Section unless specifically approved in writing by the Architect.

D. All openings required in this Section of work are to be cast into slabs or headed: No field cut openings will be allowed, except approved core drillings of circular holes 6 inches or less in diameter.

E. Install units carefully on bearing strips to prevent cracking or chipping, in strict compliance with manufacturer's printed instructions and approved shop drawings.

1. Lay units with tight joints, smooth surfaces, at right angles to bearing walls, except where angular placement is indicated on Drawings.
2. Grout all joint keys and ends of planks with mix specified in Section 2.1.K.

F. Coordinate installation of hangers for all suspended utilities where shown or scheduled.

3.2 PATCHING

A. Repair all damaged spots to Architect's satisfaction.

END OF SECTION

SECTION 035400

CONCRETE FLOOR TOPPING

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-leveling concrete floor topping.

2. 2 HR Rated Floor topping assembly

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 slab construction.

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. Field quality-control test reports.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for concrete floor toppings.

D. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. 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.

B. Mockups: Place concrete floor topping mockups to demonstrate typical joints, surface finish, bonding, texture, tolerances, and standard of workmanship.

1. Build mockups approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
2. If Architect determines that mockups do not meet requirements, demolish and remove them from the site and cast others until mockups are approved.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

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, mixing with other components, and application.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting concrete floor topping performance.

1. Place concrete floor topping only when ambient temperature and temperature of base slabs are between 50 and 86 deg F.

B. Close areas to traffic during topping application and, after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED TOPPING

A. Topping: Hydraulic-cement-based, polymer-modified, self-leveling product complying with ASTM C 387, that can be applied in minimum uniform thicknesses of 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

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. Ardex; SD-T Self-Leveling Concrete Topping.
b. BASF Building Systems; Thoro Underlayment, Self-Leveling.
c. USG; Durock Speed Floor Underlayment.
d. USG; Durock Ultra Cap Floor Underlayment.

2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
3. Compressive Strength: Not less than 5500 psi at 28 days when tested according to ASTM C 109/C 109M.

4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F.

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

1. Primer shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

1. Coating shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of concrete floor topping.

B. Verify that base concrete slabs comply with scratch finish requirements specified in Section 033000 - CAST-IN-PLACE CONCRETE.

C. Verify that base slabs are visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D 4263.

D. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

A. At the start of the installation and periodically as work progresses, provide the services of the manufacturer's technical representative at the job site as often as deemed necessary by the manufacturer to advise on all phases of this Work.

B. Install the system in accordance with manufacturer's published instructions, except where more stringent requirements are specified.

3.3 PREPARATION

A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of 1/4 inch.

1. Prepare and clean existing base slabs according to concrete floor topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.
2. Mechanically remove contaminants from existing concrete that might impair bond of floor topping.
3. Saw cut contraction and construction joints in existing concrete to a depth of 1/2 inch and fill with semirigid joint filler.

B. Fill non-moving cracks and joints as recommended by the concrete underlayment materials manufacturer.

C. Concrete Underlayment Over Concrete Slab: Prime porous surfaces of 11% (minimum) absorption with primer. Comply with underlayment concrete manufacturer's recommendations.

3.4 INSTALLATION

A. Mix materials by methods and in proportions recommended by manufacturer.

B. Maximum depth of concrete underlayment shall be 2 in. Minimum depth shall be 1/4 in. Add aggregates as recommended by manufacturer for underlayment depth over 1 in.

C. Install control joints following manufacturer's recommendations in locations indicated on the Drawings.

D. Allow underlayment to cure properly. Block off traffic and protect floor underlayment from physical damage during curing.

E. Test for dryness by taping 24 x 24 in. sections of plastic to concrete underlayment surface. After approximately 16 hours of curing, if no condensation occurs, the installation shall be considered dry and ready to receive finish flooring.

3.5 PROTECTING AND CURING

A. General: Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to concrete floor topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying floor topping, but before float finishing.

C. Begin curing immediately after finishing concrete floor topping. Cure by according to concrete floor topping manufacturer's written instructions:

3.6 JOINT FILLING

A. Prepare and clean contraction joints and install semirigid joint filler, according to manufacturer's written instructions, once topping has fully cured.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth of contraction joints. Overfill joint and trim semirigid joint filler flush with top of joint after hardening.

3.7 REPAIRS

A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will 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 completed applications of concrete floor toppings shall take place in successive stages, in areas of extent and using methods as follows:

1. Sample Sets: At point of placement, a set of 3 molded-cube samples shall be taken from the topping mix for the first 1000 sq. ft., plus 1 set of samples for each subsequent 5000 sq. ft. of topping, or fraction thereof, but not less than 6 samples for each day's placement. Samples shall be tested according to ASTM C 109 for compliance with compressive-strength requirements.
2. Concrete floor topping shall be tested for delamination by dragging a steel chain over the surface.
3. Concrete floor topping shall be tested for compliance with surface flatness and levelness tolerances.

C. Remove and replace applications of concrete floor topping where test results 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.

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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 034100 – CONCRETE REPAIR
2. All Work of Section 042000 – UNIT MASONRY

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. Embedded flashing.
3. Precast concrete units.
4. Mortar and grout.
5. Reinforcing steel, masonry joint reinforcement, ties and anchors.
6. Hoisting Equipment: The Masonry subcontractor shall furnish, install, and maintain in safe and adequate condition, all mechanical hoisting equipment, operating personnel, and rigging that is necessary for the proper execution of the Work of this Section. The requirements of Section 010000 – GENERAL REQUIREMENTS, Temporary Facilities and Controls, in relation to hoisting and rigging being the responsibility of the General Contractor, do not apply to the work of this Section.
7. Staging, Planking and Scaffolding: The Masonry subcontractor shall furnish, install and maintain in safe and adequate condition, all staging, planking and scaffolding up to eight feet in height that is necessary for the proper execution of the Work in this Section. The General Contractor shall furnish, install, and maintain in safe and adequate condition all staging, planking, and scaffolding above eight feet in height.

B. Items To Be Installed Only:

1. Section 055000 - METAL FABRICATIONS:
   a. Lintels, miscellaneous metal and iron sleeves, anchors, inserts and plates to be built into masonry walls.

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

1. Section 061600 - SHEATHING for gypsum sheathing on cold-formed metal framing.
2. Section 072100 - THERMAL INSULATION for cavity wall insulation.
3. Section 072700 - AIR BARRIERS for membrane air barrier.
4. 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. Precast Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
3. 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. 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.
3. Precast trim.
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 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. 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 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not 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.

2.2 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.

C. Standard Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi
2. Weight Classification: Normal weight.
3. Size (Width): Manufactured to dimensions specified in “Concrete Masonry Units” Paragraph above.
4. Integral Water Repellent: Provide units made with integral water repellent for exterior exposed units.
    a. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer’s mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen. Available products include:
    b. ACM Chemistries: RainBlock
    c. Addiment Incorporated, a Div. of Grace Construction Products; Block Plus W-10.
    d. GCP Applied Technologies (formerly W.R. Grace); Dry-Block.
    e. BASF Construction Chemicals; Masterpel.

D. Decorative Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3800 psi
2. Weight Classification: Normal weight.
3. Size (Width): Manufactured to dimensions specified in “Concrete Masonry Units” Paragraph above.
4. Pattern and Texture:

    a. Standard pattern, split-face finish.

5. Colors: As selected by Architect from manufacturer’s full range.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect’s sample.

7. 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. A Jandris & Sons
    b. Trenwyth Industries.
        1) Basis of Design: Cordova Stone.

    c. Westbrook Concrete Block Co.

2.3 PRECAST CONCRETE MATERIALS

A. Mold Materials
1. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
    a. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
2. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
3. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

B. Reinforcing Materials
1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
3. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M epoxy coated.
4. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, deformed, flat sheet, Type 1 bendable coating.
5. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

C. Concrete Materials
1. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
    a. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
2. Supplementary Cementitious Materials:
    a. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
    b. Metakaolin Admixture: ASTM C 618, Class N.
    c. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
    d. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
3. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
    a. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
        1) Gradation: To match design reference sample.
    b. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.

4. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
5. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
6. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

D. Stainless Steel Connection Materials
1. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
2. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
   a. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
3. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

E. Bearing Pads
1. Provide one of the following bearing pads for architectural precast concrete units as recommended by precast fabricator for application:
   a. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi, ASTM D 412.
   b. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
   c. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Division II, Section 18.10.2, or with MIL-C-882E.
   d. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plate, of type required for in-service stress.
   e. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

F. Accessories
1. Reglets: Stainless steel, Type 302 or 304, felt or fiber filled, or with face opening of slots covered.
2. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

G. Grout Materials for Precast
1. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

2.4 MORTAR AND GROUT MATERIALS FOR MASONRY

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-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer. Available products include:

1. Addiment Incorporated, a Div. of Grace Construction Products; Mortar Tite.
2. GCP Applied Technologies (formerly W.R. Grace); Dry-Block Mortar Admixture.
3. BASF Construction Chemicals; MasterPel Mortar Admixture.

H. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. 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.

C. 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.

2.6 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 DW-10-X Veneer Anchoring System by Hohmann & Barnard, consisting of a wire tie and a metal anchor section:

a. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
b. Fabricate sheet metal anchor sections and other sheet metal parts from 0.067-inch-thick, steel sheet, galvanized after fabrication.
c. Wire Ties: Triangular wire ties fabricated from 0.25-inch-diameter, hot-dip galvanized steel wire.

2.7 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.

2.8 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.

2.9 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.

2.10 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.

2.11 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.

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 PRECAST INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
4. Remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.

F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.4 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.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow 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. Set stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Masonry Joint Reinforcement: Installed in horizontal mortar joints. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
2. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. 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.

D. Coordinate and allow access for air and vapor barrier membrane installed in cavity under Section 072700 - AIR BARRIERS.

3.7 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.

3.8 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.

3.9 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.

3.10 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. 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.

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.12 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.

3.13 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.

3.14 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.

3.15 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.

3.16 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. Excess Masonry Waste: Remove excess masonry waste, and legally dispose of off the Site.

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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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.
3. All Work of Section 057300 - DECORATIVE METAL RAILINGS.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All materials and labor required for the completion of the work of this Section including but not limited to:

1. Furnishing of leveling plates, bearing plates, columns, beams, base plates, bracing, and connections (bolted angles, channels, stiffeners, separator plates, clips, supports for steel deck at columns, connections, welding filler metal, and electrodes anchor bolts, connection bolts, and erection bolts).
2. Items of structural steel required to be built into concrete or masonry as indicated or specified shall be furnished to the respective trades at the proper time with complete instruction and templates to facilitate inspection.
3. Unless specifically excluded, furnishing and installation of all other items for structural steel work indicated on the Drawings, specified, or required to make the work of this Section complete.

B. Items to be furnished only:

1. Furnish the following items for installation under designated Sections:

a. Anchor Bolts: Furnish to Section 03 30 00 and 04 20 00
b. Leveling Plates: Furnish to Section 03 30 00 and 04 20 00
c. Embedded Plates: Furnish to Section 03 30 00 and 04 20 00

1.2 RELATED REQUIREMENTS

A. The Conditions of the Contract and General Requirements of the Project Manual including the Construction Manager's Scoping documents apply to this subcontractor, material suppliers, and all other persons furnishing labor and materials under this Section. General Conditions, Supplementary Conditions, Construction Manager's Scoping documents, and applicable parts of Division 01 are included as part of this Section.

B. Work being performed by others, but related to this Section, and with which this contractor must coordinate with and/or accommodate the Work of, or which contain requirements that affect the Work of this Section include the following:

1. Section 01 45 23 – TESTING AND INSPECTING SERVICES.
2. Section 01 74 00 – CONSTRUCTION WASTE MANAGEMENT: Procedural and administrative requirements for construction and demolition recycling.
3. Section 04 20 00 - UNIT MASONRY.
4. Section 05 31 00 - STEEL DECKING.
5. Section 05 50 00 - METAL FABRICATIONS; steel lintels and light steel framing provided by those sections and connecting to work of this section.
6. Section 05 51 00 – METAL STAIRS; connection of metal stairs to structural steel, and reactions imposed.
7. Section 14 21 00 - ELECTRIC TRACTION ELEVATORS; requirements and coordination for hoisting safety beam.

8. Section 23 00 00 – HVAC; coordination and requirements of steel-framed floor and roof openings for HVAC ducts and equipment.
9. Section 26 00 00 – ELECTRICAL; grounding of electrical system to steel frame.

1.3 GENERAL REQUIREMENTS

A. Examine all other Sections of the specifications and drawings for the relationship of the work under this section and the work of other trades. Cooperate with all trades and coordinate all work under Section therewith.

1.4 PRE-INSTALLATION CONFERENCE

A. Installer of the Work of this Section is required to attend pre-installation conference specified under Section 04 20 00 – UNIT MASONRY.

1.5 QUALITY ASSURANCE

A. The General Contractor shall have available one copy of each of the following literature including latest revisions, which are hereby included in and made part of these specifications:

B. Commonwealth of Massachusetts State Building Code

C. AISC: "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".

D. AISC: "Code of Standards Practice for Steel Bridges and Buildings".

E. AISC: "Specification for Structural Joints using ASTM A325 or A490 Bolts".

F. AWS: "Code for Welding in Building Construction", with Addenda.

G. Any material or operation specified by reference to the published specifications of a manufacturer, the American Society for Testing and Materials (ASTM), the American Institute of Steel Construction (AISC), the American Welding Society (AWS), the Industrial Fasteners Institute (IFI), the Steel Structures Painting Council (SSPCV), the American National Standards Inst. (ANSI), or other published standard, shall comply with the standard listed. In case of conflict between the referenced specifications, etc., the one having the most stringent requirement shall govern. In case of conflict between the referenced specifications, etc., and the project specifications, the project specification shall govern.

1.6 SUBMITTALS

A. Samples and shop drawings are to be submitted to the Architect for approval in accordance with Section 01 30 00 – ADMINISTRATIVE REQUIREMENTS.

B. Shop drawings, erection drawings, certifications, and schedules, properly checked and coordinated with other parts of the construction, are to be submitted to the Architect for approval.

C. Without limiting the generality of the items mentioned below, shop drawings shall be complete and shall include all information necessary for the fabrication and erection of the component parts of the structure.

D. These drawings shall show: Type of steel for each member; location and identification mark of each member; dimensions, size and weight of members; connection load, type and identification

mark and camber; location and size of cuts, copes, slots, holes and openings required by other trades; type, size, and extent of all welds; joint welding procedures; welding sequence; and painting requirements (The welding symbols used shall be as adopted by the American Welding Society).

E. These drawings shall show all requirements such as (1) temporary members required for erection including connections.

F. Submit shop drawings in electronic PDF format. The documents have to be searchable and resolution independent. The PDF documents should be created directly from the detailing software and cannot be scanned from printed or hand-drawn sketches.

G. Along with the searchable PDF erection plans for each submission, provide a 3D, searchable model showing all of the structural members that are required to be reviewed. The model should be provided with a free viewer. The common detailing programs that have a free viewer available are: SDS/2, BIM Sight and SOLIBRI.

H. Except as otherwise noted the approval of shop drawings will be for size and arrangement of principal and auxiliary components and strength of connections. Any error in dimensions shown on the shop drawings shall be the responsibility of the General Contractor.

I. Fabrication of any material, cutting of any holes or performance of any work shall not proceed until shop drawings have been reviewed by the Architect.

J. Certified copies of mill test reports including names and locations of mills and shops and analysis of chemical and physical properties, of steel to be used on this project shall be submitted to the Architect before delivery to the job site.

K. Manufacturer’s certification of bolts, nuts, and filler metal for welding shall be submitted to the Architect.

L. The General 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 SER and Testing Agency or certified copies submitted upon request to the SER and the Testing Agency.

1. Methods of Erection: Prior to starting work the General Contractor shall submit to the Architect a description of the methods, sequence of erection, and type of equipment he proposes to use for erecting the structural steel work. This submission or approval shall not relieve the General Contractor of his responsibility for providing the proper methods, equipment, workmanship, or safety precautions.

1.7 DELEGATED CONNECTION DESIGN

A. Design structural steel connections indicated in the contract documents per AISC 303, Option 3, using the connection loads indicated. Submit design calculations for steel connections signed and sealed by a registered professional engineer.

1.8 TESTING & INSPECTION

A. Inspection, Testing, and Quality Control:

1. A program of Inspection and Testing of structural steel work will be established by the Structural Engineer of Record (SER) who will direct the implementation of tests as carried

out by an independent testing agency. All costs for initial inspection and testing shall be borne by the Owner. This subcontractor shall be responsible for re-inspection or retesting of defective work.

B. The materials and workmanship to be furnished under this Section shall be subject to inspection and testing in the mill, shop, and field by the SER and/or the Testing Agency. Such inspection and testing shall not relieve the General Contractor of his responsibility to provide his own inspection and quality control and to furnish materials and workmanship in accordance with the requirements of the contract documents.

C. The General Contractor and Testing Agency shall examine the contract documents and become thoroughly acquainted with detailed inspection and testing requirements as outlined by the SER.

D. The General Contractor shall cooperate with and facilitate inspection and testing by the SER and/or the Testing Agency. The General Contractor shall furnish, at his own expense, the SER and/or the Testing Agency upon request, with the following:

1. A complete set of reviewed erection drawings, detailed shop drawings, schedules, and corrective work procedures at the fabricating shop or shops in the field.
2. Cutting list, order lists, material bills, and shipping lists.
3. Information as to time and place of all rollings and shipment of material to shops
4. Representative sample pieces requested for testing.
5. Assistance for testing materials and proper facilities for inspection of the work, in the mill, shop, and field.

E. The Testing Agency shall inspect and test, as required by the SER, all welded and bolted work.

F. Weldments and bolted connections that are required by the SER and/or the Testing Agency to be corrected shall be corrected without delay at the General Contractor's expense and to the satisfaction of the SER and/or the Testing Agency. The SER or the Testing Agency shall require drawings showing proposed corrective work to be submitted for review.

G. The General Contractor shall notify the SER and/or the Testing Agency five days prior to the shipment of any structural steel so that a paint inspection can be made. At these inspections, the dry mill thickness of the paint film will be checked and steel containing mill scale that can easily be removed with the blade of a pocketknife will be subject to re-cleaning and repainting at the expense of the General Contractor.

H. Any material or workmanship which is rejected by the SER and/or the Testing Agency either in the mill, shop, or field shall be replaced promptly by the General Contractor to the satisfaction of the SER and/or the Testing Agency.

I. 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 it is found to be defective in any way.

1.9 QUALIFICATIONS

A. The General Contractor shall submit conclusive evidence to the Owner that the fabricator and the erector has satisfactorily completed projects of similar scope and have adequate fabrication facilities to meet production requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All steel is to consist of a minimum of 95 percent recycled steel with over 80 percent post-consumer and 15 percent pre-consumer recycled content.

B. All wide flange shapes shall be newly rolled steel conforming to ASTM A992, Fy = 50 KSI unless noted otherwise on drawings.

C. All bars, plates, channels, and angles shall conform to ASTM A36 unless otherwise indicated on the drawings.

D. Structural tubing shall conform to ASTM A500, Grade C with minimum yield strength Fy = 50 KSI.

E. Structural pipe shall conform to ASTM A53, Grade B.

F. Anchor bolts shall conform to ASTM A307 or ASTM F1554 Fy = 105 KSI as noted or otherwise shown on the drawings.

G. High strength bolts ASTM A325 or ASTM A490 with ASTM A563, Grade A Hex style nuts, and compatible washers. Bolts shall be cold forged with rolled threads. Bolts with torque control snap-off ends may be used.

H. Hot Dip Galvanizing shall conform to the latest ASTM specification as specified in Section 2.04 below.

I. Filler metal for welding shall conform to AISC Code, 2010 Edition, Section l.4.5.

2.2 FABRICATION

A. Applicable Standards: Except as otherwise noted on the drawings or specified, the fabrication of structural steel shall be in accordance with the AISC specifications, such as will permit proper erection.

B. Provision for attachment of other materials: Punch and drill steel for attachment of other materials indicated on the drawings or noted in the specifications to be attached to the steel.

C. Connections: Weld or bolt shop connections as indicated. Bolt field connections except where welded connections are indicated.

1. Provide high strength threaded fasteners for principal bolted connections except where unfinished bolts are indicated.
2. Provide shear tab connections for all beam to column connections where the column width is 6 in. or less.
3. For columns that are 7 in. or wider, provide a double angle connections.

D. High strength bolted construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 bolts."

E. Welding:

1. Quality control, records, certifications, and qualification of welding procedures and operations shall be as specified under Paragraph 1.6 L and Paragraph 2.3 SOURCE QUALITY CONTROL of this section.
2. Shop welding shall be done by either shielded metal-arc welding or submerged arc-welding.

3. All groove welds shall have complete penetration unless otherwise noted on the drawings.
4. Where structural joints are required to be welded, the details of all joints, the technique of welding employed, the appearance and quality of welds made and the methods used in correcting defective work shall conform to the applicable requirements of the specifications under "QUALITY ASSURANCE" in this Section.
5. The General Contractor shall prepare joint welding procedures for all welded joints which shall be approved by the SER or the Testing Agency before any welding is done. After approval, these welding procedures shall be followed without deviation unless specific approval for change is obtained from the Architect. The SER may require re-qualification of any of these welding procedures by tests prescribed in the AWS "Standard Qualification Procedure".

F. Oxygen cutting: Manual Oxygen cutting shall be done only with a mechanically-guided torch. Alternatively an unguided torch may be used provided the cut is not within a ½ in. of the finished dimension and the final removal is completed by chipping or grinding to produce a surface quality equal to that of the base metal edges. The use of oxygen-cut holes for bolted connections will not be permitted; components prepared in this manner will be rejected.

G. 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 the Testing Agency, the General Contractor shall submit to the Architect and/or SER for approval, drawings showing details of proposed corrective work and shall receive approved drawings prior to performing the corrective work. All corrective work shall be solely at General Contractor’s expense.

H. Identification: All structural steel members shall have assigned positions and identification marks or symbols, plainly indicated thereon near one end. Marks shall agree with those given on the shop drawings and erection drawings relating to or calling for the member.

2.3 SOURCE QUALITY CONTROL

A. The General Contractor shall maintain his own quality control and inspection of all shop and field work. Quality control and inspection of all welding work shall consist of meticulous supervision by the General Contractor's own welding inspector using non-destructive spot testing, at the rate of at least one test per 50 linear feet of weld by each welder, except that full penetration welds shall be tested 100 percent. Non-destructive testing shall be done by the radiographic-magnetic particle or ultrasonic method; whichever is most effective for the joint to be tested.

B. 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 it is found to be defective in any way.

2.4 GALVANIZING

A. Any items so noted or specified.

B. Galvanizing shall be hot dip galvanized after fabrication in compliance with ASTM specifications A123, A153, or A386 where applicable. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the ASTM number and the weight of the zinc coating in ounces per square foot. Galvanizer shall furnish a notarized statement of compliance with all specifications.

C. Reference Standards:

1. ASTM A153 for galvanizing iron and steel hardware.
2. ASTM A123 for galvanizing rolled, pressed and forged steel shapes, plates, bars, and strips one-eighth of an inch (1/8") thick and heavier.
3. ASTM A386 for galvanizing assembled steel products.
4. AHDGA Publication, "Inspection Manual for Hot Dip Galvanized Products"
5. ASTM A563 for tapping nuts after galvanizing.
6. ASTM A325 for galvanizing high strength bolts.

D. Grade Stamps and Certifications: Each piece of galvanized metal shall be inspected and stamped with ASTM number and weight in ounces per square foot applied. Furnish Certificates of Compliance signed by General Contractor and galvanizer stating that galvanizing complies with these specifications.

E. Packaging and Handling after Galvanizing: Suitable to prevent damage to galvanized surfaces and distortion of steel. Avoid wet stain by ensuring free circulation or air around stored material.

F. Fabricator's Responsibilities: Furnish to Galvanizer shop drawings of non-standard fabrications to coordinate fabrication with galvanizing and to avoid problems with warpage due to improper provisions for hot-dipping.

G. Touch-Up: Touch-up abraded surfaces adjacent to weldments section using 95 percent (by weight) organic zinc-rich paint over wire brush preparation per ASTM 780-80. DFT shall equal thickness required for galvanized coating in the reference standards.

2.5 PAINTING

A. Applicable Standards: Except as otherwise indicated on the drawings or specified, the painting of structural steel shall be in accordance with the SSPC specifications under "Requirements of Regulatory Agencies".

B. Steel to be painted:

1. Unless specifically excluded, all structural steel shall receive one shop coat of primer paint.
2. Surfaces requiring paint shall be painted only to within 2 in. of any field weld. If for any reason the surface to be field welded is painted, such paint shall be completely removed in the shop to within the stated limits before field welding.
3. Surfaces, inaccessible after assembly, excluding bolted, finished, or welded surfaces at connections. Surfaces encased in exterior building insulation shall receive two coats of primer paint.
4. Thoroughly clean all steel to be painted of all loose mill scale in accordance with structural steel painting council standards SP-2. Remove all rust, dirt, weld flux, weld spatter, and other foreign matter. Oil and grease deposits shall be removed.

C. Steel to be left unpainted:

1. Contact surfaces (e.g. high strength bolted connections).
2. Steel indicated on the drawings to be encased in concrete.
3. Top flange of beams to receive metal decking or steel shear studs.
4. Steel to receive spray fireproofing.

D. Shop Painting:

1. All ferrous metal surfaces, except pre-finished galvanized items and those obviously not to be painted shall, before leaving the shop or manufacturing plant, be cleaned of all scale, rust, grease, and other foreign matter and shall be given one thorough shop coat, on all

surfaces of a metal primer, ready and compatible for finish painting at the building site. Primer shall be Tnemec Co. #1009 Gray Metal Primer or approved equal by manufacturer listed under FINISHES, and shall be compatible with materials to be used in field painting and shall be used directly from factory labeled containers. Touchup damaged and abraded spots after installation using same paint.

a. After steel has been properly prepared as specified above, apply primer paint to dry steel surfaces by brush, spray, or roller assuring no running or sagging in accordance with manufacturer's directions.
b. The coverage rate per coat shall not be more than 400 square feet per gallon resulting in a wet film thickness of 2 mils.
c. Inspection of shop painting shall be specified under "Inspection, Testing and Quality Control" in this Section.

2.6 PRODUCT HANDLING

A. Handle, transport, and stack all materials carefully to prevent deformation or damage. Store all structural steel members carefully on substantial timbers and blocking, so arranged that the steel will not be in contact with the earth and properly drained, preventing any spattering with dirt or accumulation of water in or about the steel. Take care to prevent the accumulation of mud or other foreign matter on the steel.

PART 3 - EXECUTION

3.1 ERECTION

A. The General Contractor shall survey the anchor rods prior to the erection of structural steel and shall notify the design team of any misplaced anchor rods that require remedial work.

B. Applicable Standards: Except as otherwise indicated on the drawings or specified, the erection of structural steel shall be in accordance with the AISC Specification listed under "Requirements of Regulatory Agencies".

C. All beams shall be installed web normal. Add shims or other accessories, as required, to support pitched deck.

D. Methods of Erection: Prior to starting work the General Contractor shall submit to the Architect a description of the methods, sequence of erection, and type of equipment he proposes to use for erecting the structural steel work. This submission or approval shall not relieve the General Contractor of his responsibility for providing the proper methods, equipment, workmanship, or safety precautions.

E. Temporary Floors: All temporary flooring, planking, and scaffolding necessary in connection with the erection of the structural steel or the support of erection machinery shall be provided as a part of the erection work. The temporary floors shall be as required by state and municipal laws and governing safety regulations.

F. Field Connection: Unless otherwise indicated, shall be welded or bearing-type (N) high strength bolts tightened to provide the minimum tension shown in Table J3.7 of AISC "Manual of Steel Construction". Unless otherwise indicated, beams shall have framed double angle connections using ¾ in. diameter (minimum) high strength bolts in accordance with the requirements of the AISC "Manual of Steel Construction".

3.2 WELDING

A. Field welding shall be executed in accordance with all the requirements under "Fabrication Welding" in this Section, excepting those requirements that manifestly apply to shop conditions only.

B. All field welding shall be performed by manual shielded metal-arc welding only.

C. Oxygen cutting in the field will not be permitted without prior approval of the SER.

3.3 GUARANTEE

A. The General Contractor shall furnish to the Owner a written guarantee covering all defects in materials and workmanship that occur within a period of one year from the date final of completion of the building. Should any defects in materials and workmanship develop within this time, all necessary repairs and replacements shall be made at no additional cost to the Owner.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install the following items required to complete the work of this Section as shown on the drawings and specified herein:

1. Roof and floor deck.
2. Closure plates, bent angle plates, sump pans, hanger tabs, and accessories for fastening the deck to the steel frame, perimeter closure angles, and closure angles around interior openings.

1.2 RELATED REQUIREMENTS

A. The Conditions of the Contract and General Requirements of the Project Manual, including the General Contractor's Scoping documents apply to this subcontractor, material suppliers, and all other persons furnishing labor and materials under this Section. General Conditions, Supplementary Conditions, General Contractor's Scoping documents, and applicable parts of Division 01 are included as part of this Section.

B. Work being performed by others, but related to this Section, and with which this contractor must coordinate with and/or accommodate the Work of, or which contain requirements that affect the Work of this Section include the following:

1. Section 01 45 23 - TESTING AND INSPECTING SERVICES.
2. Section 01 74 00 – CONSTRUCTION WASTE MANAGEMENT: Procedural and administrative requirements for construction and demolition recycling.
3. Section 05 12 00 - STRUCTURAL STEEL FRAMING
4. Section 07 54 00 – THERMOPLASTIC MEMBRANE ROOFING
5. Section 23 00 00 – HEATING VENTILATING AND AIR CONDITIONING (HVAC); coordination and requirements of steel-framed floor and roof openings for HVAC ducts and equipment.

1.3 PRE-INSTALLATION CONFERENCE

A. Installer of the Work of this Section is required to attend pre-installation conference specified under Section 07 54 00 – THERMOPLASTIC MEMBRANE ROOFING.

1.4 QUALITY ASSURANCE

A. Any material or operation specified by reference to the published specifications or a manufacturer, the American Society for Testing and Materials (ASTM), the American Welding Society (AWS), the American Iron and Steel Institute (AISI), the Steel Deck Institute (SDI), or other published standard, shall comply with the requirements of the current specifications or standard listed. In case of a conflict between the referenced specification and the project specification, the project specification shall govern.

B. The General Contractor shall furnish a notarized affidavit from an officer of the deck manufacturer listing each material that is used, its required applicable specification, and a statement that the materials comply with the applicable specifications. However, such certification shall not relieve the General Contractor from the responsibility of complying with any added requirements specified herein.

C. Deck and erection methods shall conform to the Handbook of Industrial Loss Prevention, Chapter 75, "Wind Forces and Roof Anchorage Design", published by Factory Mutual Engineering and Research of Norwood, Massachusetts.

1.5 SUBMITTALS

A. Notarized affidavit from an officer of the deck manufacturer listing each material that is used, its required applicable specification, and a statement that the materials comply with the applicable specifications.

B. Shop drawings for steel deck shall include the name of the manufacturer and all physical properties.

C. Metal deck layout shop drawing shall be drawn no smaller than 1/8 in. = 1 ft. – 0 in. and sections showing all edge conditions and conditions around openings, changes in deck direction, etc., shall be clearly detailed drawn to a scale no smaller than 3 in. = 1 ft. – 0 in. Welds and crimps as specified herein shall also be detailed on the shop drawings. Shop drawings shall state type of steel and minimum yield point. Shop drawings will not be reviewed without all the above information clearly indicated.

D. No fabrication shall take place until the shop drawings have been reviewed.

E. All welds shall be indicated by AWS "Welding Symbols".

F. The General Contractor shall check the shop drawings and shall indicate in colored pencil his corrections, holes, etc., modifications for the other trades, and necessary field dimensions before forwarding them to the Architect for correction and review.

G. Complete calculations verifying the ability of the deck to support all design loads.

1.6 TESTING AND INSPECTION

A. Inspection, Testing, and Quality Control:

1. A program of Inspection and Testing of steel decking work will be established by the Structural Engineer of Record (SER) who will direct the implementation of tests as carried out by an independent testing agency. All costs for initial inspection and testing shall be borne by the Owner. This subcontractor shall be responsible for all costs related to re-inspection or retesting of work identified or proven to be defective.

B. The materials and workmanship to be furnished under this Section shall be subject to inspection in the shop and field by the SER and/or the testing agency. Such inspection shall not relieve the General 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 SER and/or the testing agency and the fabricator shall, when requested, aid the inspectors in carrying out their duties.

1.7 GUARANTEE

A. The General Contractor shall furnish to the Owner a written guarantee covering all defects in materials and workmanship of the work of this Section that occur within a period of one year from the date of final completion of the building. Should any defects in materials or workmanship develop within this time, all necessary repairs and replacements shall be made at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All steel is to consist of a minimum of 95 percent recycled steel with over 80 percent post-consumer and 15 percent pre-consumer recycled products.

B. Metal roof deck shall be one of the following with gage as shown on the drawings.

1. Type B, wide rib, 1 1/2 in. deep, 36 in. wide galvanized sheet carbon steel conforming to ASTM A653, Grade 40 with a minimum yield point of 40,000 p.s.i.
2. Type NS, wide ribbed, 3-in. deep, 24-in. wide galvanized sheet carbon steel conforming to ASTM A653, Grade 40 with a minimum yield point of 40,000 p.s.i.

C. Floor deck shall be one of the following with gage as shown on the drawings:

1. Floor deck shall be composite wide rib 2-inch deep sheet carbon, galvanized conforming to ASTM A611 or A653 with a minimum yield point of 40,000 p.s.i. Deck shall be formed with deformations to provide a mechanical lock between concrete and steel.

D. Roof deck shall be hot dipped galvanized to ASTM A653 coating, Class G90 with floor deck conforming to ASTM A653 coating, Class G60.

2.2 MATERIAL FABRICATION

A. Decks shall be fabricated to fit about all roof openings. Special 18 gauge edge overlapping pieces with one rib or 18 gauge channel shall be used at all edges, parallel to the span where the deck is continuous, wherever the centerline of a regular rib does not occur within 2 in. of the edge. On the sides of all openings, parallel to deck, provide a similar channel or single ribbed piece. Flat bearing must be provided at all edges of the roof and around all openings, so nailers or metal curbs will have solid bearing.

B. All deck shall be shop fabricated to proper lengths and delivered to the job with durable identification corresponding to the shop drawings.

C. Deck shall be fabricated in three span lengths or longer.

D. The General Contractor shall submit complete calculations to the Engineer. Calculations shall verify ability of the deck to support all design loads.

2.3 ACCESSORIES

A. Sixteen Gauge minimum sheet steel closures and cover plates as required to close panel end conditions where panels end, change direction, or abut.

B. Sheet steel closures for column to close openings between panels and structural steel columns.

2.4 HANDLING AND STORAGE

A. Handle and stack materials carefully in order to prevent deformation or damage during unloading and hoisting, extra care shall be taken to prevent damage to ends and sides of individual panels. If panels are to be stored prior to installation, they shall not be placed in direct contact with ground and shall be protected from elements and dry. If mud, dirt, or other foreign matter is accumulated on panels, such accumulation shall be completely removed prior to erection. All deformed or damaged panels shall be removed from the site and replaced at no additional expense to the Owner.

PART 3 - EXECUTION

3.1 ERECTION

A. Metal decking panels and accessories shall be erected and welded in accordance with the manufacturer's specification, for diaphragm action as reviewed on shop drawings, and as specified.

1. NOTE: Penetration through metal decking panels for hangers or hanger attachment devices is prohibited. Do not hang from bare metal roof deck.

B. Metal decking panels shall be shipped to the field cut to the proper length. All notching at column bevel cuts or other similar fabrication shall be performed by metal decking erector.

C. No ducts, conduits, pipes or any other mechanical, electrical, fire protection or plumbing equipment shall be supported from the metal deck.

D. Holes and openings, which are located and dimensioned on the structural drawings, shall be cut by the metal decking erector. Holes required for work by other trades will be located and cut by the respective trades. All openings cut in the metal deck panels shall be reinforced as required by the metal deck supplier. No opening shall be cut in metal decking panels unless shown on the structural drawings.

E. All cutting of metal decking panels shall be performed in a workmanlike fashion by power shears, gas-torch cold chisel, or other means reviewed by the Architect.

F. Metal decking panels shall be placed on support steel and accurately aligned to final position before being permanently fastened. All metal roof deck panels shall have a minimum bearing of 2 in. on the supporting steel.

G. If the supporting steel framework is not in proper alignment, or at the proper level, the metal decking erector shall notify the General Contractor for corrective action. The metal decking panels shall not be installed until the necessary corrections have been made.

H. Metal decking panels shall rest tightly on the flange of beams or girders of any other support surfaces.

I. Steel Decking shall be fastened to all supporting steel members as follows and as shown on the structural drawings:

1. 1 1/2 in. Deep Deck:

a. Field: 5/8 in. diameter round spot welds to steel supports at each rib, 6 in. on center;
b. Perimeter: 5/8 in. diameter round spot welds to steel supports at 6 in. on center;
c. Openings: 5/8 in. diameter round spot welds to steel supports at 6 in. on center;
d. Corners: one 3/4 in. diameter round spot weld to steel supports;
e. Sidelaps: No. 10 TEK screws at 1 ft. – 0 in. on center at sidelaps between supports.

2. 3 in. Deep Deck:

a. Field: 5/8 in. diameter round spot welds to steel supports at each rib, 8 in. on center
b. Perimeter: 3/4 in. diameter round spot welds to steel supports at 8 in. on center
c. Openings: 3/4 in. diameter round spot welds to steel supports at 8 in. on center
d. Corners: two each 3/4 in. diameter round spot welds to steel supports
e. Sidelaps: No. 10 TEK screws at 1 ft. – 0 in. on center at sidelaps between supports.

3. 2 in. and 3 in. Deep Composite Deck:

a. Field: 5/8 in. diameter round spot welds to steel supports at each rib, 12 in. on center
b. Perimeter: 5/8 in. diameter round spot welds to steel supports at 12 in. on center
c. Openings: 5/8 in. diameter round spot welds to steel supports at 12 in. on center
d. Corners: one each 5/8 in. diameter round spot welds to steel supports;
e. Sidelaps: No. 10 TEK screws at 2 ft. – 0 in. on center or closer to support wet concrete and construction loads at sidelaps between supports.

4. Spot welds shall be fully joined all around to the deck. After welding, all roof deck welds shall be painted with ZRC Cold Galvanizing Compound.

J. After welding all roof deck, welds shall be painted with ZRC cold galvanizing compound.

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.
2. Interior wall framing at partitions acting as a guard rail.
3. Interior wall framing at Seating Platform.

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 metal panel 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.

C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

D. 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 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. Super Stud Building Products Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G90.

B. 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. Steel lintels with shop-applied zinc-rich primer at interior locations.
2. Galvanized shelf angles with shop applied primer at exterior locations.
3. Steel elevator machine beams.
4. Steel support angles for elevator door sills.
5. Cants in elevator hoistways made from sheet steel.
6. Miscellaneous steel framing and supports:

    a. Steel framing and supports with shop applied primer for OT/PT.
    b. Galvanized steel framing and supports for mechanical and electrical equipment.
    c. Steel framing and supports for applications where framing and supports are not specified in other Sections; galvanized at exterior locations and in exterior walls.
    d. Prefinished slotted steel channel support framing.

7. Ladders:

    a. Steel elevator pit ladders.

8. Cast-Iron downspout boots.
9. Galvanized bench support angles and brackets with shop applied primer at exterior locations.
10. Galvanized metal panels and support framing with shop-applied primer for infilling exterior openings)

B. Items To Be Furnished Only: Furnish the following items for installation by the designated Sections

1. Section 042000 - UNIT MASONRY:

    a. Lintels, miscellaneous metal and iron sleeves, anchors, inserts and plates to be built into masonry walls.

C. 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 062010 – EXTERIOR FINISH CARPENTRY for wood benches.
4. 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.

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 D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.6, "Structural Welding Code--Stainless 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. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304 at interior, Type 316L at exterior.

C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304 at interior, Type 316L at exterior.

D. 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.

E. Steel Tubing: ASTM A 500, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

G. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.

1. Basis of Design: Unistrut Corp.

H. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.2 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.

2.3 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. Basis of Design: Tnemec; Series 394 PerimePrime.
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.

2.4 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.

2.5 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.

2.6 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inchbolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

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 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.

2.10 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. Basis of Design: Tnemec; Series 394 PerimePrime.
2. VOC Content: 340 g/L or less.

2.11 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.

2.12 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.

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 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. Preassembled 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 057300 - DECORATIVE METAL RAILINGS for stainless steel railings.
3. Section 061000 - ROUGH CARPENTRY for wood blocking for anchoring railings.
4. Section 092110 - GYPSUM BOARD ASSEMBLIES for metal backing for anchoring railings.
5. 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. Preassembled Stairs: Commercial class.
2. Ornamental Stairs: Architectural 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."
3. AWS D1.6, "Structural Welding Code--Stainless 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.

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. Basis of Design: Sika; SikaGrout 212.
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. Preassembled 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. Worthington Metal Fabricators, formerly Sharon Companies Ltd. (The).

B. Stair Framing:

1. Fabricate stringers of steel plates or channels. Provide closures for exposed ends of stringers.
2. Construct platforms of steel plate or channel 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 057300

DECORATIVE METAL 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. Decorative metal (ornamental) railings.

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

1. Section 055100 - METAL STAIRS AND RAILINGS for other steel stairs, handrails, and guardrails.
2. Section 061000 - ROUGH CARPENTRY for wood blocking for anchoring railings.
3. Section 092110 - GYPSUM BOARD ASSEMBLIES for metal backing for anchoring railings.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Stainless Steel: 60 percent of minimum yield strength.

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. Thermal Movements: Provide exterior railings 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.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 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: Show layout, spacings, sizes, thicknesses, and types of metal railings; fabrication; and fastening and anchorage details, including mechanical fasteners. Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railing 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. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Each type of glass required.
3. Fittings and brackets.
4. Welded connections.
5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

E. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

F. Welding certificates.

G. Qualification Data: For professional engineer.

1.6 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 railings that are similar to those indicated for this Project in material, design, and extent.

C. Installer Qualifications: Fabricator of products.

D. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.6, "Structural Welding Code--Stainless Steel."

F. 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 mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings 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 railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Stainless-Steel Ornamental Railings:

a. Blum, Julius & Co., Inc.
b. Blumcraft, A Division of C.R. Laurence Co., Inc.
c. HDI Railing Systems.
d. Livers Bronze Co.
e. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails, unless otherwise indicated.

1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

2.3 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304 at interior locations and 316L at exterior locations.

B. Pipe: ASTM A 312, Grade TP 304 at interior locations and 316L at exterior locations.

C. Castings: ASTM A 743, Grade CF 8 or CF 20.

D. Plate and Sheet: ASTM A 666, Type 304 at interior locations and 316L at exterior locations.

2.4 FASTENERS

A. General: Provide the following:

1. Stainless-Steel Components: Type 316 stainless-steel fasteners.
2. Dissimilar Metals: Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work, unless exposed fasteners are the standard fastening method for railings indicated.

D. Anchors: Provide anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. 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.

C. 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.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Form changes in direction as detailed on the Drawings and as standard with system selected.

H. Comply with “Guideline 1: Joint Finishes”, by National Ornamental & Miscellaneous Metals Association (NOMMA), as follows:

1. Ornamental Railing: Type 1.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.7 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 shipment.

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 same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform finish indicated, free of cross scratches.

1. Run grain of directionally textured finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum and copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink,

nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

D. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch buildup, sloped away from post.

E. Anchor steel posts to steel with flanges, angle or floor type as required by conditions, welded to posts and bolted to metal supporting members.

F. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum railings, attach posts as indicated using fittings designed and engineered for this purpose.
2. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

G. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 ANCHORING RAILING ENDS

A. Anchor railing ends to concrete and masonry as indicated on the drawings and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.

3.5 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.6 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 057300

DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section consists of providing all labor, equipment, materials, incidental work, and construction methods necessary to furnish and install designated Site Improvements and related items as indicated in the Drawings, as specified in this Section, and includes, but is not limited to, the following:

1. Steel railings including handrails and guardrails; galvanized.

B. Related Sections: The following items of related Work are specified and included in other Sections of the Specifications:

1. Section 033000 “CAST-IN-PLACE CONCRETE (SITE)” for landscape walls, stairs, concrete footings.
2. Section 321313 “CONCRETE PAVING (SITE)” for cast-in-place concrete pavement.

1.3 REFERENCES

A. The following Standards shall apply to the work of this Section:

1. ASTM: American Society for Testing and Materials:
Carbon Structural Steel: ASTM A36.
Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless: ASTM A/53/A53M.
Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products: ASTM A123.
Zinc Coating (Hot Dip) on Iron and Steel Hardware: A153.
Steel, Carbon, Cold-Rolled Sheet, Commercial Quality: A366.

2. AISI: American Iron and Steel Institute:
Code of Standard Practice

3. AWS: American Welding Society:
Structural Welding Code –Steel: D1.1.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: The Contractor is responsible for the design of all the handrail and guardrail components to conform to the Architectural and Structural Requirements in the Building Code.

Design railings, including comprehensive engineering analysis by a Professional Engineer registered in the Commonwealth of Massachusetts.

B. Structural Performance: Railings shall be designed to withstand the effects of the loads prescribed by the Building Code.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 ACTION SUBMITTALS

A. Shop Drawings: Prior to fabricating the railing components, submit large scale Shop Drawings for fabrication, installation and erection of parts of work to the Owner’s Representative for review and approval as follows:

1. Shop Drawings shall indicate plan location, sections, elevations, details, type and size of connections, grade and size of steel components, and attachment to other work.

B. Product Data: Submit manufacturer’s product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating the material comply with the requirement for the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Sealant joint around post, grout, anchoring cement, and paint products.

C. Field Measurements: Take accurate field measurements before preparing of Shop Drawings and fabrication. Do not delay job progress. Allow for field cutting and fitting where field measurements are not possible.

D. Calculations: Provide professionally prepared calculations and certifications of performance of this Work. Show how design load requirements and other performance criteria have been satisfied and stamped by a Structural Engineer registered in the Commonwealth of Massachusetts.

E. Samples for Verification: For each type of exposed finish required, showing full range of color and finish variations expected.

1. Provide minimum 12 inch long samples of sections of each distinctly different linear railing member, including handrails, guardrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
4. Show method of finishing and connecting members at intersections.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Professional Engineer, registered in the Commonwealth of Massachusetts, to design and certify the Work of the Section meets or exceeds performance requirements specified.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer whose Work has resulted in successful site railing installations.

1. Experience: Three years' experience in site railing installations of similar quality, schedule requirement, welds and procedures and construction detailing.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Mock-ups: Before beginning primary Work of this Section, provide Mock-ups at locations acceptable to the Owner's Representative and obtain acceptance of visual qualities for each type of handrail. Protect and maintain acceptable mock-ups throughout Work of this Section to serve as criteria for acceptance of this Work.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. Certification for welders shall be less than one year old and shall include type of welds and procedures qualified for and date qualified.

E. Shop Assembly: Preassemble handrails, guardrails, and railings to greatest extent possible to minimize field splicing. Disassemble units as required for shipping and handling. Clearly mark units for reassembling in field.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver railings and posts wrapped in manufacturer's standard protective coverings. Deliver brackets, fittings, sleeves, fasteners and other miscellaneous materials and products in factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from possible damage.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.9 PROJECT CONDITIONS

A. Weather: Perform exterior Work only when existing and forecasted weather conditions are within limits established by manufacturers of materials and products used.

B. Proceed with Work only when substrate construction is complete.

1.10 COORDINATION AND SCHEDULING

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 railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.11 WARRANTY

A. All decorative metal railing’s parts shall be guaranteed against workmanship and material defects for 1 year from time of delivery, or as noted herein.

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. Steel Handrails and Guardrails:

a. Julius Blum & Co., Inc., Carlstadt, NY 0702-0816.
b. CraneVeyor Corp., South El Monte, CA 91733.
c. The Sharon Companies, Ltd., Worthington, OH 43085.

2.2 METALS, GENERAL

A. Metal Surfaces, General:

1. Individual metal pieces shall be saw cut and carefully fitted together.
2. Sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.
3. Exposed surfaces shall have a smooth, sharp finish and sharp, well defined lines and arrises and without visible grinding marks, surface differentiation or variation.
4. Grind all edges of bars and plates completely free from nicks and machine marks, prior to galvanizing, shop priming, or finishing.
5. All fabricated metal items shall be fine sanded throughout to produce a high standard of surface smoothness.
6. Castings shall have sharp corners and edges and shall be clean, smooth and true to pattern.
7. Welding shall be continuous and shall extend for the entire length of the joints except where specifically indicated on the Contract Documents. All exposed welds shall be ground smooth.

8. The use of gas cutting torch in the field for correcting fabrication errors will be permitted only when the prior written approval of the Owner's Representative has been obtained for each specific condition.
9. Weld with uncoated wire to prevent flux deposits. If coated wire is used, all flux residue shall be thoroughly removed and bare white metal, prior to galvanization, if applicable. Where overlapping surfaces are welded, seal off contact area by welding all edges around the contact area.
10. All welds shall be water tight.
11. All shop connections shall be full seam welded and ground flush and smooth. Field connections bolted unless otherwise permitted as indicated on the Drawings. Draw up all threaded connections lightly, after buttering same with pipe joint compound, to exclude water. Deform threads to prevent loosening for all exposed connections subject to vandalism.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

C. Where work fabricated under other Sections has been delivered to the site and has dimensions or fabricated construction that does not fit the field conditions, notify the Owner's Representative of the discrepancy immediately.

2.3 STEEL

A. Tubing: ASTM A 500.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

3. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. 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.

E. Anchoring Grout for Posts: Aliphatic polyurethane elastomer grout

1. Iso-Flex 735 Grout by LymTal International, Inc., Lake Orion, MI, extended with 16-30 mesh sand as specified by the Manufacturer,

2. Approved equivalent.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or non-welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Non-welded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form bends by use of prefabricated elbow fittings and radius bends, as applicable changes.

K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. 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.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide stainless steel sleeves not less than 8 inches deep with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

Q. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections where and at locations indicated. Fabricate from same metal as railings.

R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in

the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL FINISHES

A. Galvanized Railings:

1. Powder coating on hot-dip galvanized steel factory applied by Duncan Galvanizing, 69 Norman Street, Everett, MA 02149; TEL: 617-389-8440, FAX: 617-389-2831; Please refer to Appendix A for additional information; or approved equal.
2. Color: **Black**
3. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
4. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
5. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
6. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
7. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
8. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Allowable Variation from True Plumb: 1/16 inch in 3 feet.
3. Allowable Variation from True Level: 1/8 inch in 20 feet.
4. Allowable Variation from True Line: 1/8 inch in 20 feet.
5. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at intervals indicated.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 ADJUSTING AND CLEANING

A. Clean metal railings by washing thoroughly with clean water and soap and rinsing with clean water.

B. 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.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 057300

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. Wood blocking, cants, and nailers.
2. Plywood backing panels.

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 plywood and 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 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Indicate component materials and dimensions and include 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.

1.4 QUALITY ASSURANCE

A. 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.

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 Azule 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 fire-rated exterior walls, 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.

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 MISCELLANEOUS MATERIALS

A. 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. Basis of Design: Henkel Corp.; OSI SF450 Heavy Duty Subfloor Construction Adhesive.
2. VOC Content: 70 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.

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. 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. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.

F. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

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.

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.

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 metal framing at exterior wall.
2. Section 061000 - ROUGH CARPENTRY for plywood backing panels.
3. Section 072700 - AIR BARRIERS for modified bituminous sheet membrane over gypsum sheathing and membrane flashing.
4. 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.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each gypsum sheathing product through one source from a single manufacturer.

B. 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 glass-mat gypsum sheathing board exposed to weather for more than 180 days.

PART 2 - PRODUCTS

2.1 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.

2.2 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

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. 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.

D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

F. 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.

END OF SECTION

SECTION 062010

EXTERIOR FINISH 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. Exterior wood benches.

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 brackets supporting benches.

2. Section 061000 - ROUGH CARPENTRY for blocking and plywood sheathing substrate for air barrier system.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Indicate bench assemblies, layouts, plans, details, and attachments.

C. Samples for Verification:

1. 12-inch-long-by-actual-width Sample of finished wood.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain wood through one source from a single manufacturer.

B. Mock-Up: Mock-up of exterior wall including wood siding is required. Comply with requirements of Section 014000, QUALITY REQUIREMENTS.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 013100 - Project Management and Coordination.

1. Meet with the Owner Project Manager; Architect, Owner insurer if applicable; testing and inspecting agency representative; siding Installer; sheathing and air barrier Installer; and installers whose work interfaces with or affects siding, including installer of curtain wall system.
2. Review methods and procedures related to siding installation, including manufacturer's.

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 substrate conditions for compliance with requirements, including flatness and fastening.
5. Review flashings, special siding details, siding penetrations, trim installation, and finishes.
6. Review temporary protection requirements for siding during and after installation.
7. Review siding observation and repair procedures after siding installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry, well-ventilated, weathertight place.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only if substrate is completely dry and if existing and forecasted weather conditions permit siding to be installed without affecting quality.

1.7 SEQUENCING

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship**."**

B. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," for lumber and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.

D. All fasteners and clips shall be concealed. Refer to drawings for details.

2.2 ACCESSORIES

A. Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Screws: Select material, type, size, and finish required for each use, nonferrous metal or hot-dip galvanized, unless otherwise indicated. Comply with ASME B18.6.1 for applicable requirements.

1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch or 3 screw-threads into substrate.

2.3 FABRICATION

A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.

B. Fabricate woodwork to dimensions, profiles, and details indicated.

C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Shop-cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and seal edges with the finish system selected for the exposed face.

E. Outside corners shall match same wood, and be mitered with a lock joint; pre-built in a shop and brought to the site.

2.4 EXTERIOR BENCHES

A. Provide Ipe, Clear Grade, absolutely no knots, Plain Sawn:

1. Sizes and Shapes: Custom milled with longest lengths as practical according to layouts as indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding 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.

3.3 INSTALLATION

A. General:

1. Do not install damaged components.
2. Install concealed fastening and clip system in accordance with manufacturer’s written installation instructions.
3. Cut edges shall be sealed with wood stain selected for the exposed face finish.

B. Construct benches as indicated in accordance with approved shop drawings.

C. Dress and sand finish carpentry work free from machine and tool marks, mill glaze, abrasions, raised grain, or other defects on surfaces exposed to view.

D. Provide tight joints formed to conceal shrinkage. Fit butt joints with concealed spline. Glue and dowel shop miters which are four inches or greater. Glue and spline miters less than 4 in., with spline concealed.

E. Blind nail work to the greatest extent possible. Where surface nailing is required by project conditions, set and fill nails to match adjacent wood. Surface nailing shall be done with nails equally spaced, vertically and horizontally aligned.

1. Provide concealed nailing as specified. Nail shall be in tongue of siding in a position where it will not be visible in the reveal when the next board is installed.
2. Where exposed surface nailing is required by project conditions, Architect shall approve location and nailing pattern.

F. Install joint sealants as specified in Division 07 Section "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND 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 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. Interior standing and running trim.
2. Plastic-laminate casework.
3. Plastic-laminate 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.
2. Section 064200 - PANELING for wood paneling.

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.

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.

1. Fire-Test-Response Characteristics of Upholstery Fabric and Padding: Comply with California Technical Bulletin 117-2013 Update, with no chemical flame retardants.

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 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. 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.

C. 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.

D. Wood Species for Opaque Finish: Any closed-grain hardwood.

E. 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.

F. 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.

2.2 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.

2.3 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, B05091; side 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.

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.

2.4 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. 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.

2. Do not use adhesives that contain urea formaldehyde.
3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

2.5 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.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: Custom.

B. Wood Species and Cut: As specified hereinabove.

1. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

C. For trim items wider than available lumber, use veneered construction. Do not glue for width.

D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.

E. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Grade: Custom.

B. Wood Species: Any closed-grain hardwood.

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.8 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.

2.9 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.

2.10 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.

2.11 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.

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. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

H. 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. Maintain veneer sequence matching of casework with transparent finish.
3. Attach casework to walls with mechanical fasteners. Do not use adhesives, so that casework may be removed and salvaged in the future.

I. 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.

J. 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.

B. Basis-of-Design:

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: Molded pebble texture.
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. VOC Content: 50 g/L or less.
2. Do not use adhesives that contain urea formaldehyde.
3. 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. VOC Content, Architectural Sealants: 250 g/L or less.
2. 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 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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 071300 - SELF-ADHERING SHEET 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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 070150 - REMOVAL OF EXISTING ROOFING
2. All Work of Section 075400 - THERMOPLASTIC MEMBRANE ROOFING
3. All Work of Section 076200 - SHEET METAL FLASHING AND TRIM

4. All Work of Section 077100 - ROOF SPECIALTIES

END OF SECTION

SECTION 070150

REMOVAL OF EXISTING ROOFING

(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. Removal of existing roofing systems and flashings down to structural deck. Refer to drawings.

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 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Inspection Report: Copy of roofing system manufacturer's inspection report indicating acceptance of existing conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

B. 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 Architect, Owner, 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 removal.
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. 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. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 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.

PART 2 - PRODUCTS

2.1 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are responsibilities of Contractor.

PART 3 - EXECUTION

3.1 ROOF TEAR-OFF

A. General: Notify the Owner and Architect each day of extent of roof tear-off proposed for that day and obtain authorization to proceed.

B. Roof Tear-Off: Carefully remove existing roofing system components down to building structure. Remove roofing materials including insulation, shingles, coverboards, membranes, flashings, and other related roofing materials.

3.2 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. If deck surface is not suitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Owner and Architect. Do not proceed with installation until directed by Owner and Architect.

3.3 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing work.

B. 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.

3.4 PROTECTING AND CLEANING

A. Protect and maintain temporary roofing until new roofing has been installed.

END OF SECTION

SECTION 071300

SELF-ADHERING SHEET 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. Rubberized-asphalt sheet waterproofing.

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 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For the following products:

1. 12-by-12-inch square of waterproofing and flashing sheet.
2. 4-by-4-inch square of drainage panel.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.5 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.

1.6 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 packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.7 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.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate not prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.
2. Warranty Period: Five years after date of Substantial Completion.
3. Warranty includes removing and reinstalling protection board, drainage panels, insulation.

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. Rubberized-Asphalt Sheet Waterproofing - Post-Applied:

a. American Hydrotech, Inc.; VM 60.
b. Carlisle Corporation, Carlisle Coatings & Waterproofing Div.; MiraDRI 860/861.
c. Cetco; Envirosheet.
d. GCP Applied Technologies (formerly W.R. Grace); Bituthene 3000.
e. Henry Company; WP 200
f. W. R. Meadows, Inc.; Mel-Rol.

2.2 RUBBERIZED-ASPHALT SHEET WATERPROOFING

A. Rubberized-Asphalt Sheet: 60-mil-thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil-thick, polyethylene film with release liner on adhesive side.

1. Physical Properties: As follows, measured per standard test methods referenced:

a. Tensile Strength: 325 psi minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F ASTM D 1970.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (movement; ASTM C 836.
e. Puncture Resistance: 50 lbf minimum; ASTM E 154.
f. Hydrostatic-Head Resistance: 200 feet (minimum; ASTM D 5385.
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.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by manufacturer of sheet waterproofing material.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

D. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as sheet waterproofing.

E. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

F. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

1. Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 4-1/2 inches wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side.

H. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

I. Protection Course: Fan-folded, extruded-polystyrene board insulation, unfaced, nominal thickness 3/8 inch.

2.4 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 and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing 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.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

F. Bridge and cover isolation joints, expansion joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 RUBBERIZED-ASPHALT SHEET APPLICATION

A. Install self-adhering sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, rubberized-asphalt sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F .

D. Horizontal Application: Apply sheets from low point to high point of decks to ensure that side laps shed water.

E. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

F. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.

G. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing as applicable.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheets extending 6 inches beyond repaired areas in all directions.

I. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 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 adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation before installing drainage panels.

3.5 FIELD QUALITY CONTROL

A. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.
2. Flood each area for 24 hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
4. Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

3.6 PROTECTION AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed insulation from damage due to ultraviolet 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.

D. 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 042000 - UNIT MASONRY for preparing concrete unit masonry walls to receive waterproofing.
3. Section 079200 - JOINT SEALANTS for elastomeric and preformed sealants in concrete and masonry walls and floors.

1.3 SUBMITTALS

A. Product Data: Include 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 and masonry 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. 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 or masonry and reacts chemically with free lime in the presence of water to develop crystalline growth within concrete or masonry capillaries to produce an impervious, dense, waterproof concrete or masonry 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 or masonry 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 or masonry surfaces.

1. Clean masonry surfaces according to ASTM D 4261.

a. Lightweight Concrete Masonry: Etch with 10 percent muriatic (hydrochloric) acid solution or abrade surface by wire brushing. Remove acid residue until pH readings of water after rinse are not more than 1.0 pH lower or 2.0 pH higher than pH of water before rinse.
b. Medium- and Normal-Weight Concrete Masonry: Sandblast or bushhammer to a depth of 1/16 inch.

2. 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.

3. Concrete Joints: Clean reveals 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 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.

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. Rigid insulation at cavity walls.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket and board insulation.
5. Spray polyurethane foam 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 072700 - AIR BARRIERS for air and vapor barrier membrane.
3. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for roofing insulation.
4. Section 092110 - GYPSUM BOARD ASSEMBLIES for acoustic insulation in gypsum board assemblies.
5. Division 22 - PLUMBING for plumbing insulation.
6. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for mechanical insulation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Cavity Wall Insulation Certification: Submit manufacturer’s certification that cavity wall insulation, as designed in the assemblies indicated on the Drawings, has been tested to meet the requirements of NFPA 285 and passed.

C. Qualification Data: For Installer of spray-applied products and Testing Agency.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Installer Qualifications: A qualified installer who has been trained by and is acceptable to spray polyurethane foam insulation manufacturer to install manufacturer's products.

C. 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.

D. Fire Test Performance for Insulation in Cavity Wall: Passes NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

E. 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 and spray polyurethane foam 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. DiversiFoam Products.
2. Dow Chemical Company.
3. Owens Corning.

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. MRc3, 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

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. DiversiFoam Products.
2. Dow Chemical Company.
3. Owens Corning.

B. Extruded-Polystyrene (XPS) Board Insulation: ASTM C 578, Type X, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, and ASTM D 1621 compressive strength of 15 pounds per square inch minimum.

1. MRc3, 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.

2.3 CAVITY WALL INSULATION, POLYISOCYANURATE BOARD

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. Atlas Roofing Corp.
2. Dow Chemical Company.
3. Rmax Inc.

B. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1 or 2, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; 25-psi minimum compressive strength.

1. Fire Resistance: NFPA 286, for interior walls.
2. Thermal Resistance: ASTM C 518, R-Value 6.5 per inch.
3. Blowing Agent: Free from CFCs, HCFCs, or HFCs.

C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

D. Joint Tape: Provide manufacturer’s recommended foil tape, as approved by the Architect.

2.4 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. NFPA 285 Assembly Fire Propagation Characteristics Testing Results: Passing.

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.

2.5 BLANKET INSULATION, GLASS FIBER 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. CertainTeed Corporation.
2. Johns Manville.
3. Knauf Insulation.
4. Owens Corning.

B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. GreenGuard certified as formaldehyde free and low chemical emissions.

C. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier). GreenGuard certified as formaldehyde free and low chemical emissions.

D. Glass-Fiber Blanket, Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier). GreenGuard certified as formaldehyde free and low chemical emissions.

E. Glass-Fiber Blanket, Foil Faced: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); 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.

2.6 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.

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.

2.7 CLOSED-CELL SPRAY POLYURETHANE FOAM INSULATION

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. Accella Polyurethane Systems; Ecobay CC/CC Polar.
2. BASF Corporation; WALLTITE.
3. Corbond Corporation, a division of Johns Manville; Corbond III.
4. Demilec (USA) LLC; Heatlok.
5. Dow Chemical Company; STYROFOAM Spray Polyurethane Foam (CM Series).
6. Henry Company; PERMAX.
7. NCFI, a Division of Barnhardt Mfg. Co.; InsulStar.

B. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type I and II.

1. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Fire Resistance: ASTM E 84, Flame Spread 75 max., and Smoke Developed 450 max.

2.8 OPEN-CELL SPRAY POLYURETHANE FOAM INSULATION

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. Accella Polyurethane Systems; Bayseal OC.
2. BASF Corporation; ENERTITE.
3. Corbond Corporation, a division of Johns Manville; Corbond ocSPF.
4. Demilec (USA) LLC; Sealection 500.
5. Henry Company; PERMAX 0.5 lb. Open Cell.
6. Icynene Inc.; Icynene Classic LD-C-50.
7. NCFI, a Division of Barnhardt Mfg. Co.; Sealite.

B. Open-Cell Polyurethane Foam Insulation:

1. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 3.6 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Fire Resistance: ASTM E 84, Flame Spread 75 max., and Smoke Developed 450 max.

2.9 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.

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.

2.10 THERMAL AND IGNITION BARRIERS

A. Thermal Barrier for Foam Plastic Insulation at Occupied Spaces: Provide thermal barrier recommended by foam plastic manufacturer and tested with the specific product. Product shall have an active building code evaluation report that lists report number and effective dates of product acceptance.

B. Ignition Barrier for Foam Plastic Insulation at Attic and Crawl Spaces, including Areas not Separated from Occupied Spaces by a Thermal Barrier: Provide ignition barrier recommended by foam plastic manufacturer and tested with the specific product. Product shall have an active building code evaluation report that lists report number and effective dates of product acceptance.

2.11 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.06 perm.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.12 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. Do not use adhesives that contain urea formaldehyde.
2. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

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. Spray Polyurethane Foam: Comply with recommendations of the American Chemistry Council, "Health and Safety Product Stewardship Workbook for High-Pressure Application of Spray Polyurethane Foam (SPF)."

1. Spray Polyurethane Foam: Spray insulation no greater than 1-1/2 inch thickness per layer. Allow each layer to fully cure before spraying additional thickness.
2. Contain and fully ventilate the area being sprayed with negative air machines, venting directly to the exterior. Do not operate permanent building HVAC system during installation. Continue ventilation during curing process.
3. Install spray polyurethane foam insulation with uniform full thickness and with density which will not displace adjacent materials.
4. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

E. 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. On units of foam-plastic board insulation, install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties (if applicable) and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates indicated. Fill gaps with compatible insulating material.

B. 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. Glass-Fiber or 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.

B. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

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 061600 - SHEATHING for sheathing substrate for air and vapor barrier system.
2. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for roof air and vapor barrier.
3. 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.

C. Fire Test Performance: Passes NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

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. Air Barrier Certification: Submit manufacturer’s certification that air barrier, as designed in the assemblies indicated on the Drawings, has been tested to meet the requirements of NFPA 285 and passed.

E. Qualification Data: For Applicator.

F. 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, FIRE-RATED TYPES

A. Self-Adhering, Vapor-Retarding Aluminum-Faced Sheet: Rubberized asphalt laminated to cross-laminated polyethylene film with aluminum facing on one side, 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 705FR-A.
b. GCP Applied Technologies (formerly W.R. Grace); Perm-A-Barrier Aluminum Wall Membranes.
c. Henry Co.; Metal Clad Membrane.

2. Thickness: 40 mils minimum.
3. Physical and Performance Properties:

a. Vapor Permeance: Not more than 0.1 perm, ASTM E 96, Water Method.

b. Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
c. Fastener Sealability: No water leaking through fastener penetration after 24 hours; ASTM D 1970.
d. Fire Test Performance: Passes NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

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.
    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 074210

METAL COMPOSITE MATERIAL PANELS

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. Metal composite material (MCM) wall and soffit panels and attachment systems.

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 metal panels.
2. Section 072100 - THERMAL INSULATION for insulation behind metal panels.
3. Section 076200 - SHEET METAL FLASHING AND TRIM for copings, flashings, and other sheet metal work not part of metal panel assemblies.
4. Section 079200 - JOINT SEALANTS for field-applied sealants not otherwise specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal composite material panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: Provide metal composite material 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.

C. Structural Performance: Provide metal composite material 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 330.

1. Wind Loads: As required by Code. As indicated on Structural Drawings.
2. Deflection Limits: Engineer metal 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.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

G. 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.

H. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
3. Distinguish between factory- and field-assembled work.

C. Delegated-Design Submittal: For metal panel assembly 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. Exterior Wall Certification: Submit manufacturer’s certification that exterior wall panels, as designed in the assemblies indicated on the Drawings, has been tested to meet the requirements of NFPA 285 and passed.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

a. Include 4-way joint for panels.

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 metal panels adjacent to joint sealants.

F. Qualifications: Qualifications of Professional Engineer and Installer.

G. Product Test Reports: For each product, tests performed by a qualified testing agency.

H. Field quality-control reports.

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 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 metal panel assemblies and providing professional engineering services needed to assume engineering responsibility.

D. Fabricator Qualifications: Certified by metal panel manufacturer to fabricate and install manufacturer's wall panel system.

E. Source Limitations: Obtain each type of metal panel through one source from a single manufacturer.

F. Fire Test Performance for Exterior Wall: Passes NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

G. 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.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to metal 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, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

I. Mockups: Provide mock-ups as specified in Section 014330 - MOCK-UPS, coordinate with other trades as required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Store metal composite material panels vertically, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

1. Do not allow storage space to exceed 120 deg F.

D. Retain strippable protective covering on metal composite material panels during installation.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material 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 metal 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 metal 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.

1.8 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, and construction of girts, studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: 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 metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL COMPOSITE MATERIAL WALL PANELS

A. General: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

B. Aluminum Composite Material Panels: Formed with 0.020-inch- (0.50-mm-) thick, aluminum sheet facings.

1. Acceptable Products: Subject to compliance with requirements, provide one of the following products:

a. 3A Composites USA, Inc.; Alucobond Plus
b. Arconic, Inc.; Reynobond FR.
c. Alpolic Materials, a division of Mitsubishi; Alpolic/pe Alpolic/fr.
d. Alucoil North America; Alucoil FR.
e. Firestone Building Products, LLC; UNA-FAB Series 1500, with fire-rated core.

2. Panel Thickness: 0.157 inch (4 mm).

3. Fire-Retardant Core: Noncombustible, with the following surface burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspection agency acceptable to authorities having jurisdiction.

    a. Flame-Spread Index: 25 or less.
    b. Smoke- Development Index: 450 or less.

C. Attachment Assembly Components: Formed from extruded aluminum.

1. Include manufacturer's standard perimeter extrusions, panel stiffeners, panel clips and anchor channels.

D. Attachment Assembly: Manufacturer's standard rainscreen system.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers.

1. Match material, finish, and color as facings of adjacent panels, unless otherwise indicated.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

1. Comply with requirements of Section 079200 - JOINT SEALANTS.

2.3 RAINSCREEN ATTACHMENT SYSTEM

A. 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.

B. Rainscreen System: Provide system that has been tested in accordance with AAMA 508 (Pressure Equalized Rain Screen Wall Cladding Test) – Standard Test Method for Water Penetration of Exterior Vented Rainscreen Panel System. The test requires a minimum airflow

of 1 CFM / SF of weather wall area through the vented rainscreen system to replicate severe storm and imperfection in air/vapor barrier system. While maintaining 1 CFM/SF airflow, the system must be able to pressure equalize and sustain zero pressure difference between the interior and exterior wall cavity without any water penetration.

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. Universe Systems, Division of Universe Corporation.
    b. LYMO Architectural Panel Systems Inc.
    c. POHL Inc. of America.
    d. Centria Architectural Systems.
    e. Metal Sales & Service, Inc.

2. Rout and return wall panel system with dry joints for rainscreen assembly.

2.4 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, 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.

1. Factory form panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
2. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
3. Dimensional Tolerances:

    a. Length: Plus 0.375 inch.
    b. Width: Plus 0.188 inch.
    c. Thickness: Plus or minus 0.008 inch.
    d. Panel Bow: 0.8 percent maximum of panel length or width.
    e. Squareness: 0.2 inch maximum.

B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. 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. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

E. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with color coat 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.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal panels is not permitted.
2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners, Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
2. Do not begin installation until weather barrier and flashings that will be concealed by metal panels are installed.

E. Rainscreen Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in

vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated.

3.4 ACCESSORY INSTALLATION

A. Accessories, General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal panel installation, including accessories.

D. Remove and replace metal panels where tests and 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.

F. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 075400

THERMOPLASTIC MEMBRANE ROOFING

(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. Adhered membrane-roofing system.
2. Cover board.
3. Roof insulation.
4. Substrate Board (thermal barrier).
5. Vapor retarder.
6. Membrane clad metal flashing.
7. Flashing for equipment mounted on roofing and roofing penetrations.

B. Items To Be Installed Only: Install the following items as furnished by the designated Sections:

1. Section 220001 - PLUMBING:

a. Roof drain covers.

C. 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 076200 - SHEET METAL FLASHING AND TRIM for metal roof penetration flashings, flashings, and counterflashings.
3. Section 079200 - JOINT SEALANTS for sealants.
4. Division 22 - PLUMBING for roof drains.
5. 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. 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 roofing system. Include plans, elevations, sections, details, and attachments to other Work.

1. Base flashings and membrane terminations.
2. Transitions to air barrier membrane.
3. Tapered insulation, including slopes.
4. Insulation fastening patterns.

C. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

D. Qualification Data: For Installer and manufacturer.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.

F. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

G. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

H. Maintenance Data: For roofing system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. 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.

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.

1.7 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 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible sheet conforming to ASTM D 6878 and formed from a thermoplastic polyolefin, internally fabric or scrim reinforced, and as follows:

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle SynTec Incorporated.
b. Firestone Building Products Company.
c. GAF Materials Corporation.
d. GenFlex Roofing Systems.
e. Johns Manville.
f. Versico Inc.

2. Thickness: 60 mils (1.5 mm) nominal.
3. Exposed Face Color: White.
4. Physical Properties:

a. Breaking Strength: 225 lbf; ASTM D 751, grab method.
b. Elongation at Break: 15 percent; ASTM D 751.
c. Tearing Strength: 55 lbf minimum; ASTM D 751, Procedure B.
d. Water Absorption: Less than 4 percent mass change after 166 hours' immersion at 158 deg F; ASTM D 471.

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.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.

C. TPO-Clad Metal Roof Flashing: Heat-weldable flashing designed to serve as gravel stop and fascia at perimeter of thermoplastic membrane roofing.

1. Composition: 24 gauge steel with G90 galvanized coating, with 0.035 in. TPO membrane laminated to the outside face. Provide unsupported width of membrane along edge to be welded to roofing membrane.
2. Profile: As shown on Drawings.
3. Product: Sure-Weld TPO Coated Metal by Carlisle
4. Exposed Face Color: Match membrane.

D. Bonding Adhesive: Manufacturer's recommended bonding adhesive.

E. Metal Termination Bars: Manufacturer's standard predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

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. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV (25 psi), 1.6-lb/cu. ft. minimum density, square edged and acceptable to roofing system manufacturer.

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. DiversiFoam Products.
b. Dow Chemical Company.
c. Pactiv/Greenguard
d. Owens Corning.

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. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

1. Cover Board Adhesive: Manufacturer’s cold fluid-applied adhesive formulated to adhere cover board to insulation substrate.

D. 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.

E. Substrate Board (Thermal Barrier): ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) 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.

2.7 ELECTRIC BREACH DETECTION SYSTEM COMPONENTS

A. Testing Source:

1. Acceptable Sources: Employ electrical conduction methods from one of the following, as approved by waterproofing system manufacturer:

a. Detec Systems
a. Honza Group, Inc.
b. International Leak Detection Ltd.
c. Leak Detection USA

2. Basis of Design: Specifications are based on the following system. Subject to compliance with Project requirements and approval by waterproofing manufacturer, equivalent systems from acceptable sources will be approved:

a. International Leak Detection Ltd, “Electric Field Vector Mapping (EFVM)”.

B. Electric Breach Detection, General: Provide permanent network of testing loops, as required to test entire waterproofing assembly.

C. Conductor Network Materials:

1. Conductor Wire: Braided polyethylene interwoven with a minimum of six strands of stainless steel wire. Tensile strength of wire shall be no less than 180 lbs.
2. Accessory Materials: Connectors and other materials as needed for complete loop or network.

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 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions and as required to comply with performance requirements.

3.4 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.

C. Tie vapor retarder to wall air barrier. Coordinate construction sequence to ensure air barrier continuity at roof to wall interfaces.

3.5 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.

I. Adhered Cover Boards: Install cover boards over mechanically-fastened 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. Adhere cover boards to mechanically-fastened insulation in ribbons of bead-applied adhesive or full-spread adhesive, as required to comply with performance and warranty requirements.

1. Locations for Adhered Cover Board Installation: Provide under green roof areas and elsewhere, where indicated.
2. Adhere cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.6 ADHERED 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. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

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. 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.

H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

3.7 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.

3.8 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.

3.9 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. Electric Breach Detection: Confirm integrity of installed roofing membrane by testing membrane for holes, open seams and capillary defects that will allow water intrusion.

1. Electric Breach Detection Procedure:

   a. Conduct testing after installing membrane and before placing pavers, test to verify membrane is watertight.
   b. Schedule testing to best meet project demands and construction schedule with ample time to allow for repairs of defects and consequential retesting.
   c. If breaches are found, conduct retest after repairs to membrane have been completed.
   d. Conduct third and final test after paver placement to verify that no damage has been done to the membrane during installation of pavers.

2. Testing Procedure:

   a. Attach EFVM impulse generator to conductor wire and ground or building structure creating a potential circuit. The circuit will complete if water finds a path to ground by way of a breech in membrane.
   b. Create a continuous conducting “plate” above the membrane by wetting some or all of the test area with water. Test only areas that are wetted.
   c. Deliver a one second long 40 volt potential electrical impulse to the conductor wire at an average rate of one impulse every two or three seconds.
   d. Detect the presence or absence of electrical flow across the surface of the membrane by systematically contacting the wet field with two noninvasive probes and reading the potentiometer linked between them.

3. Results of Testing:

   a. If, after a systematic search, no concentration of electrical flow is found, the installed membrane in that area tested is determined to be free of breaches, seam and capillary defects and will be considered waterproof at that time.
   b. If concentrations of electrical flow are found, trace and identify all contact points and therefore any breaches in the membrane. Document on a drawing and provide a written report, immediately if possible, showing the exact location of breaches found in the installed membrane in the area tested.
   c. Retest repaired defects.
   d. Record each day’s test results with a written description and photographs of all breaches and any corrections made and a schematic CAD drawing and provide three copies of the report at the completion of the roofing work.

4. Engage an independent testing agency to observe testing and examine underside of decks and terminations for evidence of leaks during testing.
5. When all areas have been tested, submit Final Report stating that the waterproofing system is “totally waterproof” consistent with warranty requirements of the roofing system manufacturer.

E. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 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 074200 - METAL WALL PANELS for factory-formed metal wall panels and flashing and trim not part of sheet metal flashing and trim.
5. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for installing sheet metal flashing and trim integral with roofing membrane.
6. Section 079200 - JOINT SEALANTS for field-applied sheet metal flashing and trim sealants.

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.

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 (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with color coat 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.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

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: 0.0187 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.

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.

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.

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 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. 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 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. Gutter Accessories: Bronze wire ball downspout strainer,

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.
2. Elevator vents.

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 ELEVATOR VENTS

A. Elevator Hoistway Penthouse Vent: Provide louvered penthouse assemblies with automatic dampers, complying with the following:

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. Airolite Corp.
    b. Industrial Louvers Inc.
    c. McDermott Metal Works Corp.

2. Basis of Design: Industrial Louvers Inc. 480XP Penthouse Louver.
3. Finish: Manufacturer's standard mill finish.

2.3 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. Elevator Vent Installation: Locate, install, and test heat and smoke vents according to NFPA 204.

1. Check vent for proper operation. Adjust operating mechanism as required.

G. 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 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 firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

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 fire-resistive joint sealers.
2. Section 079200 - JOINT SEALANTS for standard joint sealers.
3. Division 21 - FIRE SUPPRESSION for fire-protection piping penetrations.
4. Division 22 - PLUMBING for piping penetrations.
5. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for duct and piping penetrations.
6. Division 26 - ELECTRICAL for cable and conduit penetrations.

1.3 COORDINATION

A. Jobsite conditions of each through-penetration firestop 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.

B. Coordinate work with other trades to assure that penetration-opening sizes are appropriate for penetrant locations.

C. Verify that the schedule is current at the time of construction, and that each referenced system is suitable for the intended application.

1.4 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. 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 firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

a. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop 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 firestop 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 firestop systems not requiring removal of insulation.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Either a firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors" or a firm experienced in installing through-penetration firestop 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.

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 through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. 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 firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop 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 firestop system products bear classification marking of qualified testing and inspecting agency.
b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed in the UL “Fire Resistance Directory.”

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. 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, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to the following:

1. Hilti, Inc.
2. BioFireshield; RectorSeal Corporation.
3. Specified Technologies, Inc. (STI).
4. 3M; Fire Protection Products Division.

2.2 FIRESTOPPING MATERIALS

A. 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.

B. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

C. Materials: Provide through-penetration firestop 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. Basis of Design:

    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 Intumescent Firestop Sealant.

D. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

E. Endothermic Mats: 3M Interam Endothermic Mats by 3M Fire Protection Products; located in rated walls behind cabinet unit heaters, fire extinguisher cabinets and electrical panels where there are space limitations to maintain the wall rating.

2.3 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 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 1705.17.1. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

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. BioFireshield; RectorSeal Corporation.
3. Specified Technologies, Inc. (STI).
4. 3M; Fire Protection Products Division.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. 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.

B. 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.

C. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079.

D. 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.

E. 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.

F. 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.

G. 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. 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.

C. 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 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. Basis of Design: Armacell Canada Inc.; ITP Standard Backer Rod.

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 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.

3.5 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 080001

METAL WINDOWS

(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: 080001 – METAL WINDOWS

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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 085110 - ALUMINUM WINDOWS.

END OF SECTION

SECTION 080002

GLASS AND GLAZING

(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: 080002 – GLASS AND GLAZING

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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 088000 - GLAZING.

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.
2. Standard hollow-metal steel 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.

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. Ceco Door Products; an ASSA ABLOY Group Company.
2. CURRIES Company; an ASSA ABLOY Group Company.
3. de LaFontaine
4. Deronde Steel Doors and Frames.
5. Mesker Door Inc.
6. Pioneer Industries, Inc.
7. Philipp Manufacturing Company.
8. Republic Builders Products Company.
9. Steelcraft; an Allegion (formerly Ingersoll-Rand) company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated, (Galvanized) Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 metallic coating.

D. 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.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. 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.

G. Insulation: Comply with requirements in Section 092110 - GYPSUM BOARD ASSEMBLIES.

H. Glazing: Comply with requirements in Section 088000 - GLAZING.

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) 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) 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.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. 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.

7. 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.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. 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.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated (Galvanized) 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.
2. Factory finishing for wood doors.
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 064020 - INTERIOR ARCHITECTURAL WOODWORK for wood door frames.
2. Section 087100 - DOOR HARDWARE for hardware for wood doors.
3. Section 088000 - GLAZING for glass and glazing requirements.
4. 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. Typical Veneer:

a. Grade: AWI Premium, with AWI Grade AA faces, 4 inch veneer width.
b. Species and Cut: Select White Maple, plain sawn/sliced.
c. Match between Veneer Leaves: Book match.
d. Assembly of Veneer Leaves on Door Faces: Center-balance.

2. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
3. Transom Match: Continuous match.
4. Stiles: Same species as face.
5. Cross-Banding: 1/8 in. high density fiberboard, no added formaldehyde (NAF).
6. 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. Particle Core: ANSI A 208.1, Grade 1-LD-2.
2. Agrifiber Core: ANSI A 208.1, Grade 1-LD-2.
3. Structural Composite Lumber Core: WDMA I.S.10, Timberstrand LSL.
4. 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 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 ,with glass and glazing.
2. Exterior and interior manual-swing aluminum doors, with glass and glazing.

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.

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: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.
2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

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.

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)."

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.

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. Exterior 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. Exterior Storefront, Thermal Break, 2 inch by 6-1/2 inch profile:
   a. EFCO Corporation, 406X.
   b. Kawneer North America, equal.
   c. Oldcastle BuildingEnvelope, equal.
   d. Tubelite Inc., equal.
   e. YKK AP America Inc., equal.

3. Interior Storefront, 1-3/4 inch by 4-1/2 inch profile:
   a. EFCO Corporation, 401 NT.
   b. Kawneer North America, Trifab 400.
   c. Oldcastle BuildingEnvelope, FG-1000.
   d. Tubelite Inc., INT45.
   e. YKK AP America Inc., YES 40 FS.

4. Interior Doors, Wide Stile:
   a. EFCO, a Pella Company, D-500.
   b. Kawneer North America, 500.
   c. Oldcastle BuildingEnvelope, WS-500.
   d. Tubelite Inc., Wide.
   e. YKK AP America Inc., 50D.

5. Exterior Doors, Wide Stile, Thermally-Broken:
   a. EFCO, a Pella Company, D-502.
   b. Kawneer North America, Insulpour 500T.
   c. Oldcastle BuildingEnvelope, WS-500TC.
   d. Tubelite Inc., Wide Thermal Block.
   e. YKK AP America Inc., 50XT.

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. Hardware Sets: Provide as specified in Section 087100 - DOOR HARDWARE.

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 (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with color coat containing not less than 70 percent polyvinylidene fluoride resin by weight). Coatings shall be fluorosurfactant free Kynar 500 by Arkema or fluorosurfactant-compliant Hylar 500 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 084523

FIBERGLASS-SANDWICH-PANEL 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. Aluminum-framed assemblies glazed with fiberglass sandwich panels (translucent) window wall and operable clear insulating glass assemblies.

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 sealants installed at perimeters of assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fiberglass sandwich panel assemblies, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. 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.

B. Structural-Test Performance: Provide glazed aluminum curtain-wall systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Duration: As required by design wind velocity but not less than 10 seconds.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/60 of clear span.

D. Thermal Movements: Provide glazed aluminum curtain-wall 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.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for assemblies.

B. Shop Drawings: For assemblies. Include plans, elevations, sections, details, and attachments to other work.

1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For each type of exposed finish required, in manufacturer's standard sizes.

D. Samples for Verification: Submit 12 by 12 inch sample panel assemblies, for each color selected.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

F. Maintenance Data: For assemblies to include in maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing Work of this Section and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of data for structured panel assemblies including shop drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' 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.

C. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

D. NFRC Certification: Provide fiberglass sandwich panels that are certified for U-factors indicated according to NFRC 100 and listed in its "National Fenestration Council Incorporated - Certified Products Directory."

E. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to glazed aluminum curtain-wall systems 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, inspecting, and certifying procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain-wall 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 glazed aluminum curtain-wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of 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, but not limited to, excessive deflection.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Fiberglass-Sandwich-Panel Warranty: Manufacturer's standard form in which manufacturer agrees to replace panels that exhibit defects in materials or workmanship.

1. Defects include, but are not limited to, the following:

a. Delamination of coating, if any, from exterior face sheet.

b. Discoloration of exterior face sheet of more than 8.0 units Delta E when measured according ASTM D 2244.
c. Delamination of panel face sheets from panel cores.

2. Warranty Period: 10 years from date of Substantial Completion.

C. Special Aluminum-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. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
2. Warranty Period: 10 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. Kalwall Corporation.
2. Major Industries, Inc.
3. Approved equal.

2.2 ALUMINUM FRAME SYSTEMS

A. Aluminum: Alloy and temper recommended in writing 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.

B. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

C. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than 0.040 inch thick.

D. Frame-System Gaskets: Manufacturer's standard.

E. Anchors, Fasteners, and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A 193/A 193M, 300 series stainless-steel screws.
2. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

F. 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.

G. Anchor Bolts: ASTM A 307, Grade A, hot-dip zinc coating, ASTM A 153/A 153M, Class C or mechanically deposited zinc coating, ASTM B 695, Class 50.

H. Frame System Fabrication:

1. Fabricate components before finishing.
2. Fabricate components that, when assembled, have the following characteristics:

   a. Profiles that are sharp, straight, and free of defects or deformations.
   b. Accurately fitted joints with ends coped or mitered.
   c. Internal guttering systems or other means to drain water passing joints, condensation occurring within components, and moisture migrating within the assembly to exterior.

3. Fabricate sill closures with weep holes and for installation as continuous component.
4. Reinforce components as required to receive fastener threads.
5. Weld components 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.

2.3 FIBERGLASS SANDWICH PANELS

A. Panel Construction: Assembly of uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core and complying with requirements applicable to panel materials in ICBO ES AC04, "Sandwich Panels."

1. Face-Sheet, Self-Ignition Temperature: 650 deg F or more per ASTM D 1929.
2. Face-Sheet Burning Extent: 1 inch or less per ASTM D 635.
3. Face-Sheet, Smoke-Developed Index: 450 or less per ASTM E 84.
4. Interior Face-Sheet, Flame-Spread Index: Not more than 25 per ASTM E 84.
5. U-Value: 0.23 U-factor Thermally Broken
6. Visible Light Transmittance (VLT): 26 %.
7. Solar heat gain coefficient .30
8. Grid pattern as viewed: As indicated on Drawings

B. Panel Thickness: 2-3/4 inches.

C. Grid Core: Mechanically interlocked extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.

1. Extruded Aluminum: ASTM B 221, in alloy and temper recommended in writing by manufacturer.
2. Grid Pattern: As indicated on Drawings.

D. Face Sheets:

1. Exterior face sheet: Smooth, .070 thick and Crystal in color
2. Interior face sheet: Smooth, .045 thick and White in color.

E. Insulation: Manufacturer’s standard translucent aerogel material.

F. Fiberglass-Sandwich-Panel Adhesive: ASTM D 2559.

G. Panel Fabrication: Factory assemble and seal panels.

2.4 FIXED AND OPERABLE SASHES

A. Windows:

1. Windows shall be designed specifically for inclusion in the translucent panel unit wall system and factory unitized to panels.

    a. Units shall be of the following type(s):

        1) Project-out bottom
        2) Fixed lite

2. Performance: Windows shall pass or exceed requirements of AAMA/WDMA/CSA-101/I.S.2/A440-05 (08).

    a. HC-2000 projected windows: PI-AW50, PO-HC55; shall pass requirements at 75 psf uniform structural load with air infiltration <.01 CFM/FT2 at 6.24 psf and no water penetration at 10 psf (PI) and 8 psf (PO)
    b. HC-2000 fixed widows: F-AW80; shall pass requirements at 120 psf uniform structural load with air infiltration <.01 CFM/FT2 at 6.24 psf and no water penetration at 12 psf.

3. Construction: All window frame members shall be of heavy gauge 6063-T5 extruded aluminum with a thermal break. Frame sections shall be coped and joined by stainless steel screws at each corner. All joints exposed to the weather shall be sealed with an elastic compound. All openings shall be double weather stripped using T-slot bulb gaskets to insure minimum air infiltration.

    a. Operating sash shall be hollow extruded design, mitered and joined with heavy reinforcing corners.
    b. Both operable and fixed lites shall be inside glazed with an expanded EPDM closed cell sponge gasket to exterior, with aluminum glazing bead and a driven EPDM wedge gasket to the interior for rapid removal and replacement.

4. Hardware:

    a. Hinges on operating windows shall be four bar stainless steel with adjustable friction blocks.
    b. HC-2000 Projected windows: Locking hardware shall be of cam lever design and shall be made of cast white bronze.

5. Glazing:

    a. Heavy commercial (HC2000) windows shall be glazed with 1” double insulated glass,
    b. Glazing Specification: Refer to Section 088000.

6. Finish is to be coordinated with closure system.
7. Insect Screens to be be supplied.

    a. Constructed of hollow box extruded frame
    b. Mitered with reinforcing corners mechanically joined

c. Screens for project-out windows shall be equipped with wickets for access to handles
d. Screen cloth shall be of 18-16 aluminum mesh and held in place by spline

B. Opaque Panels:

1. Aluminum faces:

a. Materials: Panel face shall be two ply construction consisting of .063” aluminum and .125” thick hardboard.
b. Construction: Components shall be laminated as one monolithic unit by a laminator with minimum 15 years of experience. Adhesive shall be permanent elastic type neoprene rubber based applied to 100% of the surface.
c. Finish: Provide colors as selected by Architect from manufacturer’s full range and as follows:

1) Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Finish shall be coordinated with closure system.

2.5 ACCESSORY MATERIALS

A. Isolation Coating (Bituminous Paint): ASTM D 1187, VOC compliant, cold-applied asphalt-mastic paint, containing no asbestos, formulated for 30-milthickness per coat.

2.6 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 (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with color coat containing not less than 70 percent polyvinylidene fluoride resin by weight). Coatings shall be fluorosurfactant free Kynar 500 by Arkema or fluorosurfactant-compliant Hylar 500 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 between aluminum components 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 and to prevent impeding movement of moving joints.
6. Weld aluminum components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight, unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with bituminous paint or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.

D. Install components to drain water passing joints, condensation occurring within aluminum members and panels, and moisture migrating within assembly to exterior.

E. Install components plumb and true in alignment with established lines and elevations.

F. Coordinate with sealants and installation of perimeter sealants which is specified in Section 079200 - JOINT SEALANTS.

G. Erection Tolerances: Install assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION

SECTION 085110

ALUMINUM WINDOWS

(Part of Work of Section 080001 - METAL WINDOWS, 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. Fixed aluminum-framed 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 084110 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
2. Section 088000 - GLAZING for requirements for glass and glazing.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:

1. Minimum size required by AAMA/NWWDA 101/I.S.2.

B. AAMA/NWWDA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.

1. Performance Class: Architectural Grade AW.
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 the following:

C. Structural Performance: Provide aluminum 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 as required by Code. Deflection may 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 aluminum 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 aluminum 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 aluminum 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 aluminum 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: For each type of product indicated.

1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

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. Thermal-break details.
7. Glazing details.
8. Window cleaning provisions.
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: Full-size operable window of each type of window.

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 aluminum window. Test results based on use of downsized 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 aluminum window manufacturer for installation of units required for this Project.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

C. 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 windows that are similar to those indicated for this Project in material, design, and extent.

D. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

E. Product Options: Information on Drawings and in Specifications establishes requirements for aluminum 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.

F. 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 aluminum windows with an attached label.

G. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

H. 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.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to aluminum 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 aluminum 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 aluminum 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 aluminum 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: Ten years from date of Substantial Completion.

C. Warranty Period for Metal 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. EFCO, a Pella Company.
2. Graham Architectural Products Corp.
3. Kawneer North America.
4. Peerless Products, Inc.
5. Wausau Window and Wall Systems.

2.2 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, not less than 16,000-psi (110-MPa) minimum yield strength, and not less than 0.062-inch (1.6-mm) thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch (3.2 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Replaceable Weather Seals: Comply with AAMA 701/702.

F. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

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): 0.29.
d. Shading Coefficient: 0.43.
e. Solar Heat Gain Coefficient: 0.37.

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. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.4 FABRICATION

A. General: Fabricate aluminum 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. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

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. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with AAMA/NWWDA 101/I.S.2.

2.5 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 (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with color coat 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.

1. Color and Gloss: As selected by Architect 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 windows where test results indicate that they do 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. 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 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

Section includes:

1. Mechanical and electrified door hardware for:
    a. Swinging doors.
2. Electronic access control system components
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

Section excludes:

4. Windows
5. Cabinets (casework), including locks in cabinets
6. Signage
7. Toilet accessories
8. Overhead doors

Related Sections:

9. Division 01 Section “Alternates” for alternates affecting this section.
10. Division 06 Section “Rough Carpentry”
11. Division 06 Section "Finish Carpentry”
12. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
13. 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”
14. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
15. Division 26 “Electrical” sections for connections to electrical power system and for low-voltage wiring.
16. Division 28 “Electronic Safety and Security” sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

UL - Underwriters Laboratories

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

DHI - Door and Hardware Institute

5. Sequence and Format for the Hardware Schedule
6. Recommended Locations for Builders Hardware
7. Keying Systems and Nomenclature
8. Installation Guide for Doors and Hardware

NFPA – National Fire Protection Association

9. NFPA 70 – National Electric Code
10. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
11. NFPA 101 – Life Safety Code
12. NFPA 105 – Smoke and Draft Control Door Assemblies
13. NFPA 252 – Fire Tests of Door Assemblies

ANSI - American National Standards Institute

14. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
15. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
16. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
17. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
18. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

    a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
    b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
    c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

Action Submittals:

3. 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.
4. 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.

5. 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.

6. 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.

7. 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.

8. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

Informational Submittals:

9. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
10. 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.

Closeout Submittals:

11. 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. Factory order acknowledgement numbers (for warranty and service)
    d. Name, address, and phone number of local representative for each manufacturer.
    e. Parts list for each product.
    f. Final approved hardware schedule edited to reflect conditions as installed.
    g. Final keying schedule
    h. Copies of floor plans with keying nomenclature
    i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
    j. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

Inspection and Testing:

12. Submit a written report of the results of functional testing and inspection for fire door assemblies, in compliance with NFPA 80.

    a. Written report to be provided to the Owner and be made available to the Authority Having Jurisdiction (AHJ).
    b. Report to include the door number for each fire door assembly, door location, door and frame material, fire rating, and summary of deficiencies.

13. Submit a written report of the results of functional testing and inspection for required egress door assemblies, in compliance with NFPA 101.

    a. Written report to be provided to the Owner and be made available to the Authority Having Jurisdiction (AHJ).
    b. Report to include the door number for each required egress door assembly, door location, door and frame material, fire rating, and summary of deficiencies.

1.04 QUALITY ASSURANCE

Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

    a. Warehousing Facilities: In Project's vicinity.
    b. Scheduling Responsibility: Preparation of door hardware and keying schedules.
    c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this Project.
    d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
        1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

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.

Certifications:

5. 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 Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

6. 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.

7. Electrified Door Hardware

a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

8. 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.

Pre-Installation Meetings

9. 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.

10. 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.

11. 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

Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

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.

Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

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.

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.

Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

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.

Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.07 WARRANTY

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: 3 year
        2) Exit Devices
            a) Von Duprin: 3 year
        3) Closers
            a) LCN 4000 Series: 30 year

    b. Electrical Warranty
        1) Exit Devices
            a) Von Duprin: 1 year

1.08 MAINTENANCE

Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”

1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

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.

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

Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

5. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
6. Use materials which match materials of adjacent modified areas.

7. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

8. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Ives 5BB series

2. Acceptable Manufacturers and Products:

    a. McKinney TA/T4A series
    b. Stanley FBB series

Requirements:

3. Provide hinges conforming to ANSI/BHMA A156.1.
4. Provide five knuckle, ball bearing hinges.
5. 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

6. 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

7. 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

8. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
9. 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.
10. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
11. 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

12. Provide hinges with electrified options as scheduled in the hardware sets. Provide with enough and wire gage 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 ELECTRIC POWER TRANSFER

Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10
2. Acceptable Manufacturers and Products:
   a. No Substitute

Requirements:

3. 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.
4. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.05 PIVOT SETS

Manufacturers:

1. Scheduled Manufacturer:
   a. Ives
2. Acceptable Manufacturers:
   a. Rixson
   b. ABH

Requirements:

3. Provide pivot sets complete with oil-impregnated top pivot, unless indicated otherwise.
4. Where offset pivots are specified, Provide one intermediate pivot for doors less than 91 inches (2311 mm) high and one additional intermediate pivot per leaf for each additional 30 inches (762 mm) in height or fraction thereof. Intermediate pivots spaced equally not less than 25 inches (635 mm) or not more than 35 inches (889 mm) on center, for doors over 121 inches (3073 mm) high.
5. Provide appropriate model where pivot sets are scheduled at fire rated openings.
6. Provide lead-lined model where pivot sets are specified at lead-lined doors.
7. Provide pivots with electrified options as scheduled in the hardware sets. Provide with enough and wire gage to accommodate electric function of specified hardware. Locate electrified pivot nearest to electrified locking component. If manufacturer of electrified locking component requires another device for power transfer, then provide recommended power transfer device and appropriate quantity of pivots.
8. Provide mortar guard for each electric pivot specified, unless specified in hollow metal frame specification.

2.06 FLUSH BOLTS

Manufacturers:

1. Scheduled Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

    a. Burns
    b. Trimco

Requirements:

3. 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 COORDINATORS

Manufacturers:

1. Scheduled Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

    a. Burns
    b. Don-Jo

Requirements:

3. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
4. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 MORTISE LOCKS

Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Sargent 11 line T zone cylindrical

2. Acceptable Manufacturers and Products:

a. No Substitute

Requirements:

3. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
4. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
5. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
6. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
7. 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.
8. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
9. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
10. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and 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.

11. 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.

    Lever Design: Schlage 06A.

2.09 EXIT DEVICES

Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Von Duprin 99/33A series

2. Acceptable Manufacturers and Products:

    a. No Substitute

Requirements:

3. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.

4. Cylinders: Refer to “KEYING” article, herein.
5. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
6. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
7. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
8. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
9. Provide flush end caps for exit devices.
10. Provide exit devices with manufacturer’s approved strikes.
11. 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.
12. 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.
13. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
14. 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.
15. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
16. Provide electrified options as scheduled.
17. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
18. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 POWER SUPPLIES

Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:

    a. Dynalock 5000 series
    b. Securitron BPS series

Requirements:

3. Provide power supplies approved by manufacturer of supplied electrified hardware.
4. 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.
5. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
6. 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

Manufacturers:

1. Scheduled Manufacturer and Product:

    a. Best

2. Acceptable Manufacturers and Products:

    a. No Substitute

Requirements:

3. Provide interchangeable cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

Construction Keying:

4. Replaceable Construction Cores.

    a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
        1) 3 construction control keys
        2) 12 construction change (day) keys.

    b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.12 KEYING

Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

    a. Master Keying system as directed by the Owner.

2. 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.
3. Provide keys with the following features:

    a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s).

4. Identification:

    a. Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. 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.
    d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
    e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

5. Quantity: Furnish in the following quantities.

    a. Change (Day) Keys: 3 per cylinder/core.
    b. Permanent Control Keys: 3.
    c. Master Keys: 6.

2.13 KEY CONTROL SYSTEM

Manufacturers:

1. Scheduled Manufacturer:

    a. Telkee

2. Acceptable Manufacturers:

    a. HPC
    b. Lund

Requirements:

Key control is managed offsite by Owner. Dormakaba/Best on the Cormax SFIC 7 pin core system and is controlled using Keyston Web software. The key schedule and all codes should be provided and uploaded into that system.

2.14 DOOR CLOSERS

Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products:

    a. No Substitute

Requirements:

3. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
4. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
5. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
6. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
7. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
8. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
9. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
10. Pressure Relief Valve (PRV) Technology: Not permitted.
11. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
12. 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 DOOR OPERATOR

Door Operators: Provide low energy closer/opener device that conforms to ANSI A156.19 standards and UL requirements. Provide a ten-year warranty on the closer body and a two-year warranty on the complete system. Provide HD arms that contain a spring action stop to prevent damage. Provide any mounting plates needed for the proper installation and use of these units.

1. LCN 4640 as listed in sets.

2. Besam, 350/450 series.

3. Hager 8400 series

2.16 DOOR TRIM

Manufacturers:

1. Scheduled Manufacturer:

a. Ives.

2. Acceptable Manufacturers:

a. Trimco
b. Burns

Requirements:

3. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.17 PROTECTION PLATES

Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

Requirements:

3. 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.
4. 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.
5. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.18 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

Manufacturers:

1. Scheduled Manufacturers:

a. Glynn-Johnson

2. Acceptable Manufacturers:

a. Rixson
b. ABH

Requirements:

3. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
4. Provide friction type at doors without closer and positive type at doors with closer.

2.19 DOOR STOPS AND HOLDERS

Manufacturers:

1. Scheduled Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

    a. Trimco
    b. Burns

Provide door stops at each door leaf:

3. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
4. Where a wall stop cannot be used, provide universal floor stops.
5. Where wall or floor stop cannot be used, provide overhead stop.
6. 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

Manufacturers:

1. Scheduled Manufacturer:

    a. Zero International

2. Acceptable Manufacturers:

    a. National Guard
    b. Reese

Requirements:

3. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
4. 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.
5. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
6. 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

Manufacturers:

1. Scheduled Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

    a. Burns
    b. Trimco

Requirements:

3. Provide "push-in" type silencers for hollow metal or wood frames.
4. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
5. Omit where gasketing is specified.

2.22 DOOR POSITION SWITCHES

Manufacturers:

1. Scheduled Manufacturer:

    a. Schlage

2. Acceptable Manufacturers:

    a. GE-Interlogix
    b. Sargent

Requirements:

3. Provide recessed or surface mounted type door position switches as specified.
4. 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.

2.23 FINISHES

Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
3. Protection Plates: BHMA 630 (US32D)
4. Overhead Stops and Holders: BHMA 630 (US32D)
5. Door Closers: Powder Coat to Match
6. Wall Stops: BHMA 630 (US32D)
7. Latch Protectors: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

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.

Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing doors and frames for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

    a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

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

Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

Lock Cylinders:

5. Install construction cores to secure building and areas during construction period.
6. Replace construction cores with permanent cores as indicated in keying section.
7. Furnish permanent cores to Owner for installation.

Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

8. Conduit, junction boxes and wire pulls.
9. Connections to and from power supplies to electrified hardware.
10. Connections to fire/smoke alarm system and smoke evacuation system.
11. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
12. Connections to panel interface modules, controllers, and gateways.
13. Testing and labeling wires with Architect’s opening number.

Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

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.

Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

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.

Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

Inspection and Testing:

1. Provide functional testing and inspection of fire door assemblies by a qualified person in accordance with NFPA 80.

    a. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.1.
    c. Correct all deficiencies and schedule a reinspection of fire door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect fire door assemblies after repairs are made.

2. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101.

    a. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.2.
    c. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect required egress door assemblies after repairs are made.

3.05 ADJUSTING

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.

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.

3.06 CLEANING AND PROTECTION

Clean adjacent surfaces soiled by door hardware installation.

Clean operating items per manufacturer’s instructions to restore proper function and finish.

Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

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.

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.

Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

Hardware Sets:

HARDWARE GROUP NO. 01 - (EXTERIOR ALUMINUM SINGLE WITH PUSH/PULL BAR X NARROW BACKSET MORTISE LOCK)
For use on Door #(s):
007
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	PIVOT SET	7226F SET	IVE
1	EA	INTERMEDIATE PIVOT	7226F INT	IVE
1	EA	MORTISE LOCK	8748 1-1/2" L X L	ACC
1	EA	MORTISE CYLINDER	AS REQUIRED	SAR
1	EA	OVERHEAD STOP	CONCEALED HEAVY DUTY 100S SERIES	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	SET	SEALS	BY ALUMINUM DOOR SUPPLIER	
1	EA	DOOR SWEEP	BY ALUMINUM DOOR SUPPLIER	
1	EA	DRIP CAP	BY ALUMINUM DOOR SUPPLIER	
1	EA	THRESHOLD	BY ALUMINUM DOOR SUPPLIER	
1	EA	DOOR CONTACT	679-05HM/WD	SCE

ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.

HARDWARE GROUP NO. 02 - (ALUMINUM PAIR VESTIBULE WITH PUSH/PULL HARDWARE)
For use on Door #(s):
000
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	PIVOT SET	7226F SET	IVE
2	EA	INTERMEDIATE PIVOT	7226F INT	IVE
2	EA	PUSH/PULL BAR	9190-0	IVE
2	EA	OVERHEAD STOP	CONCEALED HEAVY DUTY 100S SERIES	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
1	SET	SEALS	BY ALUMINUM DOOR SUPPLIER	

HARDWARE GROUP NO. 03 - (EXTERIOR ALUMINUM PAIR WITH ELECTRIC RIM PANIC HARDWARE X REMOVABLE MULLION X CARD READER)
For use on Door #(s):
EX000
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	PIVOT SET	7226F SET	IVE
2	EA	INTERMEDIATE PIVOT	7226F INT	IVE
2	EA	POWER TRANSFER	EPT10 CON	VON
1	EA	KEYED REMOVABLE MULLION	KR4954	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-EO-CON	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-NL-OP-CON	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	SAR
1	EA	DOOR OPERATOR	4640	LCN
1	EA	RIM CYLINDER	AS REQUIRED	SCH
2	EA	OFFSET DOOR PULL	8190-0	IVE
2	EA	OVERHEAD STOP	CONCEALED HEAVY DUTY 100S SERIES	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
1	SET	SEALS	BY ALUMINUM DOOR SUPPLIER	
2	EA	DOOR SWEEP	BY ALUMINUM DOOR SUPPLIER	
1	EA	DRIP CAP	BY ALUMINUM DOOR SUPPLIER	
1	EA	THRESHOLD	BY ALUMINUM DOOR SUPPLIER	
2	EA	DOOR CONTACT	679-05HM/WD	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	VON
1	EA	CREDENTIAL READER	SPECIFIED ELSEWHERE	

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. 04 - (EXTERIOR SINGLE WITH STOREROOM LOCKSET)
For use on Door #(s):
EX015B
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	L9080	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	DRIP CAP	142	ZER
1	EA	GASKETING	429	ZER
1	EA	DOOR SWEEP	39	ZER
1	EA	THRESHOLD	8655A (VERIFY JAMB DEPTH)	ZER
1	EA	DOOR CONTACT	679-05HM/WD	SCE

NOTE: VERIFY EXISTING CONDITIONS IN FIELD PRIOR TO ORDERING HARDWARE.
ALL WIRING AND CONNECTIONS BY DIVISION 26.
OPERATIONAL DESCRIPTION:
DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.

~~HARDWARE GROUP NO. 05 - (EXTERIOR SINGLE WITH STOREROOM LOCKSET)~~
~~For use on Door #(s):~~

~~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~~	~~L9080~~	~~SCH~~
~~1~~	~~EA~~	~~SURFACE CLOSER~~	~~4111 SCUSH~~	~~LCN~~
~~1~~	~~EA~~	~~KICK PLATE~~	~~8400 10" X 2" LDW B-CS~~	~~IVE~~
~~1~~	~~EA~~	~~DRIP CAP~~	~~142~~	~~ZER~~
~~1~~	~~EA~~	~~GASKETING~~	~~429~~	~~ZER~~
~~1~~	~~EA~~	~~DOOR SWEEP~~	~~39~~	~~ZER~~
~~1~~	~~EA~~	~~THRESHOLD~~	~~8655A (VERIFY JAMB DEPTH)~~	~~ZER~~
~~1~~	~~EA~~	~~DOOR CONTACT~~	~~679-05HM/WD~~	~~SCE~~

~~NOTE: VERIFY EXISTING CONDITIONS IN FIELD PRIOR TO ORDERING HARDWARE.~~
~~ALL WIRING AND CONNECTIONS BY DIVISION 26.~~
~~OPERATIONAL DESCRIPTION:~~
~~DOOR CONTACT CONNECTED TO BUILDING'S SECURITY SYSTEM.~~

HARDWARE GROUP NO. 06 - (EXTERIOR PAIR WITH ELECTRIC RIM PANIC HARDWARE X REMOVABLE MULLION X CARD READER)
For use on Door #(s):
EX100A EX100B
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
2	EA	POWER TRANSFER	EPT10 CON	VON
1	EA	KEYED REMOVABLE MULLION	KR4954	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-99-L-M996-06-FSE	VON
1	EA	ELEC PANIC HARDWARE	RX-99-EO	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	SAR
1	EA	RIM CYLINDER	AS REQUIRED	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	DOOR OPERATOR	4640	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	DRIP CAP	142	ZER
2	EA	GASKETING	429	ZER
2	EA	DOOR SWEEP	39	ZER
1	EA	THRESHOLD	8655A (VERIFY JAMB DEPTH)	ZER
1	EA	MULLION SEAL	8780N	ZER
2	EA	DOOR CONTACT	679-05HM/WD	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	VON
1	EA	CREDENTIAL READER	SPECIFIED ELSEWHERE	

NOTE: VERIFY EXISTING CONDITIONS IN FIELD PRIOR TO ORDERING HARDWARE.
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 EXITS AND DOOR CONTACTS CONNECTED TO BUILDING'S SECURITY SYSTEM.

HARDWARE GROUP NO. 07 - (SINGLE WITH PASSAGE SET)
For use on Door #(s):
221 224
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	L9010	SCH
1	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 08 - (SINGLE WITH PRIVACY SET)
For use on Door #(s):
214 215 225
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	STOP	WS407/FS436 AS SPECIFIED	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 09 - (SINGLE WITH PASSAGE SET X CLOSER)
For use on Door #(s):

004	005	006	007C	008	009B
103	104	105	106	106B	106C
201	203	204	206	207	208
209	211	212	217	218	219
220	222	226			

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	L9010	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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. 10 - (SINGLE WITH PASSAGE SET X CLOSER)
For use on Door #(s):
010 106A 210A
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	L9010	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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

NOTE: VERIFY EXISTING CONDTIONS IN FIELD PRIOR TO ORDERING HARDWARE.

HARDWARE GROUP NO. 11 - (SINGLE WITH PASSAGE SET X CLOSER)
For use on Door #(s):
210
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	L9010	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
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. 12 - (SINGLE WITH PRIVACY SET X CLOSER)
For use on Door #(s):
002 003 102E 107 107A
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	4011/4111EDA AS SPECIFIED	LCN
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. 13 - (SINGLE WITH PRIVACY SET X CLOSER)
For use on Door #(s):
202 216 223
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	4011/4111EDA AS SPECIFIED	LCN
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

NOTE: VERIFY EXISTING CONDTIONS IN FIELD PRIOR TO ORDERING HARDWARE.

HARDWARE GROUP NO. 14 - (SINGLE WITH OFFICE LOCKSET X CLOSER)
For use on Door #(s):
007A 007 102C 102D 102G
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	OFFICE/ENTRY LOCK	L9050 L583-363	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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. 15 - (SINGLE WITH OFFICE LOCKSET X CLOSER)
For use on Door #(s):
102 102A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
1	EA	OFFICE/ENTRY LOCK	L9050 L583-363	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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

NOTE: VERIFY EXISTING CONDTIONS IN FIELD PRIOR TO ORDERING HARDWARE.

HARDWARE GROUP NO. 16 - (SINGLE WITH STOREROOM LOCKSET X CLOSER)
For use on Door #(s):
010A 011 203A 203B 204C 208A
208B 209B 209C 217A 218C 221A
222C
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	L9080	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
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. 17 - (SINGLE WITH STOREROOM LOCKSET X CLOSER)
For use on Door #(s):
108B 108C
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	L9080	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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

NOTE: VERIFY EXISTING CONDTIONS IN FIELD PRIOR TO ORDERING HARDWARE.

HARDWARE GROUP NO. 18 - (SINGLE WITH STOREROOM LOCKSET X CLOSER)
For use on Door #(s):
102B 213
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	L9080	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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. 19 - (SINGLE WITH STOREROOM LOCKSET X CLOSER)
For use on Door #(s):
009A
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	L9080	SCH
1	EA	OVERHEAD STOP	CONCEALED HEAVY DUTY 100S SERIES	GLY
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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. 20 - (SINGLE WITH STOREROOM LOCKSET X CLOSER)
For use on Door #(s):
205
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	L9080	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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. 21 - (SINGLE WITH RIM FIRE EXIT HARDWARE)
For use on Door #(s):
ST3-2
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	99-L-BE-F	VON
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
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. 22 - (SINGLE WITH RIM FIRE EXIT HARDWARE WITH TACTILE WARNING)
For use on Door #(s):
015 015A
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	99-L-NL-F X TACTILE WARNING	VON
1	EA	RIM CYLINDER	AS REQUIRED	SCH
1	EA	SURFACE CLOSER	4111 EDA	LCN
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. 23 - (PAIR WITH PASSAGE SET X FLUSH BOLTS X CLOSER AT ACTIVE LEAF)

For use on Door #(s):

012 013 014

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
2	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED	IVE
1	EA	PASSAGE SET	L9010	SCH
1	EA	SURFACE CLOSER	4011/4111EDA AS SPECIFIED	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
2	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
2	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 24 - (PAIR WITH STOREROOM LOCKSET X FLUSH BOLTS X CLOSER AT ACTIVE LEAF)

For use on Door #(s):

001 206A 207C 217B 219A 220C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
2	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED	IVE
1	EA	STOREROOM LOCK	L9080	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
2	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
2	EA	SILENCER	SR64	IVE

~~HARDWARE GROUP NO. 25 - (PAIR WITH STOREROOM LOCKSET X AUTOMATIC FLUSH BOLTS X CLOSER)~~

~~For use on Door #(s):~~

~~Provide each PR door(s) with the following:~~

~~QTY~~		~~DESCRIPTION~~	~~CATALOG NUMBER~~	~~MFR~~
~~6~~	~~EA~~	~~HINGE~~	~~5BB1 SERIES AS SPECIFIED~~	~~IVE~~
~~1~~	~~SET~~	~~AUTO FLUSH BOLT~~	~~FB31P/FB41P AS REQUIRED~~	~~IVE~~
~~1~~	~~EA~~	~~DUST PROOF STRIKE~~	~~DP1/DP2 AS REQUIRED~~	~~IVE~~
~~1~~	~~EA~~	~~STOREROOM LOCK~~	~~L9080~~	~~SCH~~
~~1~~	~~EA~~	~~COORDINATOR~~	~~COR X FL X MB AS REQUIRED~~	~~IVE~~
~~2~~	~~EA~~	~~SURFACE CLOSER~~	~~4011/4111EDA AS SPECIFIED~~	~~LCN~~
~~2~~	~~EA~~	~~KICK PLATE~~	~~8400 10" X 1" LDW B-CS~~	~~IVE~~
~~2~~	~~EA~~	~~STOP~~	~~WS407/FS436 AS SPECIFIED~~	~~IVE~~
~~1~~	~~EA~~	~~ASTRAGAL~~	~~328 X 2 PC~~	~~ZER~~
~~1~~	~~EA~~	~~GASKETING~~	~~488S~~	~~ZER~~

HARDWARE GROUP NO. 26 - (PAIR - DOUBLE EGRESS - WITH SURFACE VERTICAL LESS BOTTOM ROD FIRE EXIT HARDWARE)
For use on Door #(s):
100
Provide each DE door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
2	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR	VON
2	EA	SURFACE CLOSER	4111 EDA	LCN
4	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
2	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	ASTRAGAL	328 X 2 PC	ZER
1	EA	GASKETING	488S	ZER

HARDWARE GROUP NO. 27 - (PAIR WITH SURFACE VERTICAL LESS BOTTOM ROD FIRE EXIT HARDWARE X SMOKE GASKETING)
For use on Door #(s):
ST1-2 ST3-0 ST3-1
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	IVE
2	EA	FIRE EXIT HARDWARE	9927-L-BE-F-LBR	VON
2	EA	SURFACE CLOSER	4111 EDA	LCN
4	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
2	EA	STOP	WS407/FS436 AS SPECIFIED	IVE
1	EA	ASTRAGAL	328 X 2 PC	ZER
1	EA	GASKETING	488S	ZER

HARDWARE GROUP NO. 28 - (EXISTING DOORS)
For use on Door #(s):
001A 001C 108 102F 101 201B
211B
Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	MFR
1	ALL HARDWARE	EXISTING TO REMAIN	

HARDWARE GROUP NO. 29 - (EXISTING DOORS)
For use on Door #(s):
202A 203D 204B 208D 209D
217C 218B 221C 222B
Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	MFR
1	ALL HARDWARE	EXISTING TO REMAIN	

NOTE: DOORS TO BE FIXED CLOSED.

HARDWARE GROUP NO. 30 - (EXISTING DOORS)
For use on Door #(s):
001B
Provide each PR door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	MFR
2	ALL HARDWARE	EXISTING TO REMAIN	

HARDWARE GROUP NO. 31 - (DOUBLE-ACTING IMPACT DOORS)

For use on Door #(s):

103B	105A	108A	201A	203C	204A
206B	207A	208C	209A	211A	218A
219B	220A	221B	222A		

Provide each DA door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	MFR
1	ALL HARDWARE	BY DOOR MANUFACTURER	

END OF SECTION

SECTION 088000

GLAZING

(Part of Work of Section 080002 - GLASS AND GLAZING, 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. 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. Interior lites.
c. Unframed mirrors.
d. 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.
2. Section 084110 - ALUMINUM FRAMED ENTRANCES AND STOREFRONTS.
3. Section 085110 - ALUMINUM WINDOWS 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): 0.29.
d. Shading Coefficient: 0.43.
e. Solar Heat Gain Coefficient: 0.37.

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.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

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. Fire-Rated Monolithic Ceramic Glazing Material (Not for Doors or Locations Requiring Safety Glazing): Proprietary product in the form of clear flat sheets of 3/16-inch nominal (5.0 mm) thickness weighing 2.5 lb/sq. ft. and as follows:

1. Fire-Protection Rating: As indicated for the fire window in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Products: Subject to compliance with requirements, provide the following:

    a. Technical Glass Products (TGP); FireLite Premium, polished both sides.

I. Fire-Rated Laminated Ceramic Glazing Material (for Doors and Locations Requiring Safety Glazing): Category II safety glazing product in the form of 2 lites of clear ceramic glazing material laminated together to produce a laminated lite of 5/16-inch nominal (8.0 mm) thickness; polished on both surfaces; weighing 4 lb/sq. ft. and as follows:

1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Polished on both surfaces, transparent.
3. Products: Subject to compliance with requirements, provide one of the following:

    a. Technical Glass Products (TGP); FireLite Plus.
    b. Safti First; Pyran Platinum L, (for maximum 90 minute-rated openings).
    c. Vetrotech Saint-Gobain; SGG Keralite FR-L.

J. 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.

K. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.

1. Glass: Clear float.
2. Ceramic Coating Color: Custom color as selected by the Architect.

L. Ceramic-Coated Vision Glass: Float glass with ceramic enamel applied by silk-screened process and complying with ASTM C 1048, Condition C (other coated glass), Type I (transparent flat glass), Quality-Q3, Specification No. 95-1-31 in GANA Tempering Division's "Engineering Standards Manual," and other requirements specified.

1. Ceramic Frit Pattern: Custom pattern as selected by the Architect.
2. Ceramic Coating Color: Custom color as selected by the Architect.

M. Silicone-Coated Spandrel Glass: ASTM C 1048, Condition C, Type I, Quality-Q3, and complying with other requirements specified.

1. Products: Subject to compliance with requirements, provide ICD High Performance Coatings, Opaci-Coat 300; color as selected by Architect from manufacturer’s full range.

N. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

1. Mirror Edge Treatment: Flat polished edge.

O. 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 Content:

    a. Structural Glazing Adhesives: 100 g/L.
    b. Architectural Sealants: 250 g/L.

5. 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 Content: 250 g/L or less.
2. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
3. 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 089000

LOUVERS AND VENTS

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 extruded-aluminum louvers and frames.
2. Elevator vents.

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 sealants installed in perimeter joints between louver frames and adjoining construction.
2. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and wind loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers. Loads as required by Code.

B. Seismic Performance: Provide louvers capable of withstanding the effects of earthquake motions as required by code.

C. Thermal Movements: Provide louvers 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 ambient; 180 deg F material surfaces.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.

1. For installed louvers indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: For each type of metal finish required.

D. Qualification Data: For professional engineer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code--Aluminum."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify louver 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 louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

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. Airolite Company, LLC.
2. American Warming and Ventilating.
3. Construction Specialties, Inc.
4. Greenheck.

5. Industrial Louvers, Inc.
6. McDermott Metal Works Corporation
7. Nystrom Building Products.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 ELEVATOR VENTS

A. Elevator Vents: Factory-fabricated horizontal or through-wall dampered elevator vents as detailed on the Drawings meeting local state building code requirements.

2.5 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Storm-Resistant Louvers:

1. Louver Depth: 4 inches.
2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch.
3. Performance Requirements:

    a. Free Area: Comply with requirements indicated on the Drawings.
    b. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rain fall rate of 3 inches per hour and a wind speed of 29 mph at a core area intake velocity of 300 fpm.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.6 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

2.7 BLANK-OFF PANELS

A. Insulated, Blank-off Panels: Laminated metal-faced panels consisting of insulating core surfaced on back and front with metal sheets.

1. Thickness: 1 inch.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: Rigid insulation board.
4. Seal perimeter joints between panel faces and louver frames with 1/8-by-1-inch PVC compression gaskets.
5. Panel Finish: Same finish applied to louvers.

2.8 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 (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with color coat 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.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, 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. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 - JOINT SEALANTS for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

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 _____ 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 _____ 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 _____, or may be obtained by written or telephone request; telephone _____.

3. Sub-bids filed with the _____ 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 _____ 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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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 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 at cementitious tile backing panels.

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 the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

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. MRc3, 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. Chicago Metallic Corporation; Drywall Furring System.
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. EB Metal U.S.
3. Marino\WARE.
4. Studco Building Systems.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0312 inch (20 gauge).

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); SLP-TRK 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.
d. Metal-Lite, Inc.; The System Slotted Track.

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: 1-1/2 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: Provide galvanized steel and resilient material sound-isolation clips, equal to the following:

1. Kinetics Noise Control Co.; IsoMax.
2. PAC International, Inc.; RSIC-1.
3. Pliteq, Inc.; GenieClip.
4. Studco Building Systems; Resilmount A237R.

J. Spring Isolation Hangers: Provide galvanized and coated spring hanger system, equal to the following:

1. Kinetics Noise Control Co.; ICW.
2. PAC International, Inc.; RSIC--SI-CRC Pro Series.

K. 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.

L. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

M. 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.
2. Thickness: 1/2 inch.
3. Long Edges: Tapered.

C. Gypsum Wallboard, Fire-Resistant Type X: ASTM C 1396.

1. Basis of Design: USG; SHEETROCK EcoSmart Panels Firecode X.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

D. Abuse-Resistant Type: ASTM C 1629. Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular-type and Type X gypsum board.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.

E. 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.
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 Units: 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 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.

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 Units: Thinset, nonsag mortar, as recommended by backing unit manufacturer. Refer to Section 093000 - TILING.
2. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

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 units, 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; EcoTouch SAB.
   c. Owens Corning; Thermafiber SAFB FF.
   d. Rockwool (formerly Roxul); AFB evo.

2. 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.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

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 system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. 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 (above ceilings, etc.), 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 Units: ANSI A108.1, at locations indicated to receive tile, with joints treated to comply with ANSI A108.11.

B. Water-Resistant Backing Board: Install at areas not subject to wetting and elsewhere as indicated with 1/4-inch gap where panels abut other construction or penetrations.

C. 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: 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 Units: Finish according to manufacturer's written instructions.

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 (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 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 to comply with requirements specified in Section 078100 - APPLIED FIREPROOFING.

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

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.

I. In elevator shafts where gypsum board shaft wall assemblies cannot be positioned within 2 inches of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2- or 5/8-inch- thick, gypsum board cants covering tops of projections.

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to the shaft wall framing.

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. Wall, and base tiles.
2. Setting materials and accessories.
3. 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 joints between dissimilar materials.
2. Section 083110 - ACCESS DOORS AND FRAMES for installation in tile.
3. Section 092110 - GYPSUM BOARD ASSEMBLIES for tile backer units.

1.3 DEFINITIONS

A. Module Size: Actual tile size plus joint width indicated.

B. Face Size: Actual tile size, excluding spacer lugs.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

1. For feature spaces including lobbies, reception areas, corridors, food service areas and similar spaces provide layout drawings based on measured as-building conditions.

C. Samples for Verification:

1. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. 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. Metal Edge Strips: 6-inch lengths.

D. Qualification Data: For Installer.

E. Material Test Reports: For each tile setting product.

1.5 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.

1.6 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.

1.7 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.

1.8 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 suppression 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. Large Format Tiles are defined as more than 12 inches in any nominal dimension.

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. Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes selected from manufacturer's standard shapes.

2.3 EDGE STRIPS

A. Metal Edge Strips: 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.
3. Material: ASTM A 666, stainless steel, 300 series, with No. 4 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: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

1. Basis of Design: MAPEI; Mapecem Quickpatch.

C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
2. For wall applications, provide nonsagging mortar.

a. For glass tile wall applications, provide white color mortar.

D. 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.

E. Tile Grout, Epoxy Type: ANSI A118.3, chemical resistant, water cleanable, tile grouting epoxy.

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; CEG-IG.
b. Laticrete; SpectraLock Pro.
c. MAPEI; Kerapoxy.

2. Color: To be selected by Architect from manufacturer’s full range.

F. 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.

G. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

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 installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards 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 before installing tile.
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. 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. 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 "Specifications for 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.

C. 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.

D. 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.

E. 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.

F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

G. Expansion 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. 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.

H. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.4 CLEANING AND PROTECTING

A. 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.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. 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.

D. 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 Manual.

B. Wall Tile, Typical Over Cementitious Backer-Board: 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.

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.
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.

B. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. 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.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. 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.

D. 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.

E. 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 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.

2.2 ACOUSTICAL PANELS, GENERAL

A. Products: Subject to compliance with specified requirements, provide one of the following products for each type indicated.

B. Acoustical Ceiling Type ACT-1: General use and as indicated.

1. Manufacturer and Model Number:

a. USG, Mars ClimaPlus No. 86985.
b. Certainteed Ceilings, Symphony M. 1222F-OVT-1.
c. Armstrong, Ultima No. 1912.

2. Panel Size: 24 inches by 24 inches by 3/4 inch.
3. Panel Mounting: Revealed edge.
4. Noise Reduction Coefficient (NRC): Not less than 0.70.
5. Ceiling Attenuation Class (CAC): Not less than 35.
6. Color: White.
7. Grid Material: Painted steel.
8. Grid Face Width: 9/16 inch.

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.

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.
2. 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.
2. 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 of Work of 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.

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. Vinyl composition tile.
2. Resilient wall base and accessories.
3. Resilient stair accessories.
4. Substrate preparation for resilient flooring and accessories.

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

1. Section 096800 - CARPETING for carpet accessories.

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.

1. For adhesives and sealants, include VOC content.

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.

D. 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 VINYL COMPOSITION TILE

A. Vinyl Composition Tile (VCT): ASTM F 1066.

1. Armstrong World Industries, Inc.
2. Congoleum Corporation.
3. Tarkett Inc.

B. Style and Colors: As indicated on the Finish Legend.

C. Thickness: 0.125 inch

D. Size: 12 by 12 inches.

2.2 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.

1. Armstrong World Industries, Inc.
2. Mannington Burke.
3. Johnsonite, a division of Tarkett.
4. Marley Flexco (USA), Inc.
5. Nora Systems, Inc.
6. Roppe Corporation.

B. Style and Colors: As indicated on the Finish Legend.

C. Type (Material Requirement): TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).

D. Shape: Straight (toeless) at carpet and coved at resilient flooring.

E. Minimum Thickness: 0.125 inch.

F. Height: 4 inches.

G. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

H. Outside Corners: Premolded.

I. Inside Corners: Premolded.

J. Surface: Smooth.

2.3 RESILIENT STAIR ACCESSORIES

A. Treads and Risers: ASTM F 2169.

1. Mannington Burke.
2. Endura
3. Johnsonite, a division of Tarkett.
4. Mondo Rubber International, Inc.
5. Nora Systems, Inc.
6. Roppe Corporation.

B. Style and Colors: As indicated on the Finish Legend.

C. Material: Rubber, Composition A.

D. Size: Lengths and depths to fit each stair tread in one piece.

E. 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.

2.4 RESILIENT MOLDING ACCESSORY

A. 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. Mannington Mills, Inc.
2. Endura
3. Johnsonite, a division of Tarkett.
4. Mondo Rubber International, Inc.
5. Nora Systems, Inc.
6. Roppe Corporation.

B. Material: Rubber.

C. Profile and Dimensions: As indicated.

2.5 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.

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.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

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.

E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

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.

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 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.

3.4 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.

3.5 RESILIENT ACCESSORY INSTALLATION

A. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. 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.

3.6 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. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.

    a. Coordinate selection of floor polish with the Owner's maintenance service.

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. Epoxy flooring systems.

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 sealants installed at joints in resinous flooring systems.

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.

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, the Installer, the Architect, the Owner’s Representative and the Owner’s Testing Agency. 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. Owner’s Testing Agency 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

E. Testing:

1. ASTM E 1907 Standard Guide to Methods of Evaluating Moisture Conditions of Concrete Floors to Receive Resilient Floor Coverings
   a. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub-floor Using Anhydrous Calcium Chloride
   b. ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
   c. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in situ Probes
2. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
3. ASTM D 4501 Standard Test Method for Shear Strength of Adhesive Bonds Between Rigid Substrates by the Block-Shear Method

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. Stonhard, Inc.

4. 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

A. Troweled epoxy mortar with clear epoxy receiving coat, decorative quartz broadcast and clear epoxy sealer coat.

B. System Characteristics:

1. Color: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Textured for slip resistance.
3. Integral Cove Base: 4 inches high with 1 inch radius.
4. Overall System Thickness: 3/16 inch (not including osmotic pressure barrier or grout).
5. VOC: Less than 100 g/l.

C. Components: Multi-layered trowel applied waterproof flooring surfacing system shall be composed of a primer bondcoat, waterproof membrane, traffic surfacing and finish coats, and shall conform to the following standards:

1. Traffic surface binder and all rubber emulsions shall be compounded with an aqueous synthetic rubber liquid containing no hydrocarbon solvents.
2. Aggregate for traffic surface coating shall be suitably graded mineral aggregate passing a #20 mesh sieve and retained on a #80 mesh sieve.
3. Fabric used as reinforcement for waterproof base and floor shall be 7-1/2 oz. woven polypropylene fabric.
4. Final Finish dressing shall be a single component, water-phase acrylic latex emulsion material, pigmented and of a consistence suitable for roller application.

D. System Components: Manufacturer's standard components which are compatible with each other and as follows:

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.

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. Verify that concrete substrates are dry.
   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate as required by the manufacturer.
   b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
   c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
4. Verify that concrete substrates have neutral pH and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application 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. Apply reinforcing membrane to substrate cracks.

D. 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.

E. Apply self-leveling slurry body coat(s) in thickness indicated for flooring system.

1. Broadcast aggregates and, after resin is cured, remove excess aggregates to provide surface texture indicated.

F. Apply troweled or screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

G. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 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. 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. Carpet type, color, and dye lot.
3. Seam locations, types, and methods.
4. Type of subfloor.
5. Type of installation.
6. Pattern type, repeat size, location, direction, and starting point.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. 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.

1.8 EXTRA MATERIALS (ATTIC STOCK)

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Tiles equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

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. InterfaceFLOR.
2. J&J Invision Carpet.
3. Milliken & Co.
4. Mohawk Group.
5. Shaw, a Berkshire Hathaway Co.
6. 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.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the carpet manufacturer.

A. 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. 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. Provide adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

B. 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. Carpet Tile Pattern: As directed by Architect.
4. 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 097200

WALL COVERINGS

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. Vinyl wall covering.

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 primers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

C. Samples for Verification: Full width by 3 ft. long section of wall covering.

1. Sample from same print run or dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.

D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

E. Qualification Data: For qualified testing agency.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.

G. Maintenance Data: For wall coverings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: As follows, per ASTM E 84:

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

2. Fire-Growth Contribution: Textile wall coverings tested according to NFPA 265 and complying with test protocol and criteria in the 2003 IBC.

B. 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 mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 WALL COVERINGS

A. General: Provide rolls of each type of wall covering from same print run or dye lot.

2.2 VINYL WALL COVERING

A. Vinyl Wall-Covering Standards: Provide mildew-resistant products complying with the following:

1. ASTM F 793 for strippable wall coverings that qualify as Category V, Type II, Commercial Serviceability products.

B. Colors, Textures, and Patterns: As indicated on the Finish Schedule.

2.3 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.

1. Adhesive shall have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099000 - PAINTING AND COATING and recommended in writing by wall-covering manufacturer for intended substrate.

C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.

D. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
4. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

G. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.3 INSTALLATION

A. General: Comply with wall covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.

B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

D. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.

E. Match pattern 6 ft. above the finish floor.

F. Install seams vertical and plumb at least 6 in. from outside corners and 6 in. from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.

G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

H. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

3.4 CLEANING

A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

SECTION 098430

SOUND-ABSORBING PANELS

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. Back-mounted acoustical wall panels.

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.
2. Section 095100 - ACOUSTICAL CEILINGS for acoustical ceiling panels supported by exposed suspension system and tested for noise reduction.

1.3 DEFINITIONS

A. NRC: Noise reduction coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of panel edge, core material, and mounting indicated.

B. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials.

C. Coordination Drawings: Show intersections with wall base, electrical receptacles and switches, and other adjacent work.

D. Samples for Initial Selection: For each type of fabric facing material from acoustical wall panel manufacturer's full range.

E. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work.

1. Fabric: Full-width by 36-inch-long Sample from dye lot to be used for the Work, and as follows:

a. With specified treatments applied.
b. Show complete pattern repeat.

c. Mark top and face of fabric.

2. Panel Edge: 12-inch-long Sample showing edge profile, corner, and finish.
3. Core Material: 12-inch-square Sample showing corner.
4. Mounting Device: Full-size Sample.
5. Sample Panels: No larger than 36 by 36 inches. Show joints and mounting methods.

F. Product Certificates: For each type of acoustical wall panel, signed by product manufacturer.

G. Qualification Data: For fabricator and testing agency.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of acoustical wall panel.

I. Maintenance Data: For acoustical wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

J. Warranty: Special warranty specified in this Section.

1.5 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: Obtain acoustical wall panels through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

C. Protect panel edges from crushing and impact.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical wall panels 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.

B. Lighting: Do not install acoustical wall panels until a permanent level of lighting is provided on surfaces to receive acoustical wall panels.

C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within specified warranty period.

1. Failure in performance includes, but is not limited to, acoustical performance.
2. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:

1. Decoustics Ltd.
2. Kinetics Noise Control.
3. MBI Products Company.
4. Quiet Concepts, a division of PCI Industries.
5. Sound Concepts.
6. Wall Technology, an Owens Corning Company.

2.2 CORE MATERIALS

A. Glass-Fiber Board: ASTM C 612, Type IA or Types IA and IB; density as specified, unfaced, dimensionally stable, molded rigid board, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

1. Nominal Core Density: 4 to 7 lb/cu. ft.

2.3 BACK-MOUNTED, EDGE-REINFORCED ACOUSTICAL WALL PANELS WITH GLASS-FIBER BOARD CORE

A. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass-fiber board core; with edges chemically hardened to reinforce panel perimeter against warpage and damage.

1. Nominal Core Thickness: 1 inch
2. Overall System NRC: Not less than 0.80, for Type A mounting per ASTM E 795.
3. Panel Width: As indicated on Drawings
4. Panel Height: Fabricated height as indicated on Drawings.

5. Panel Edge Detail: Square.
6. Corner Detail: Square to form continuous profile to match edge detail.

B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.

1. Manufacturer: As indicated on the Finish Schedule.

C. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, and as follows:

1. As recommended by manufacturer.

2.4 FABRICATION

A. Sound-Absorption Performance: Provide acoustical wall panels with minimum NRCs indicated, as determined by testing per ASTM C 423 for mounting type specified.

B. Acoustical Wall Panels: Panel construction consisting of facing material adhered to[face,] edges and back border of dimensionally stable core; with rigid edges to reinforce panel perimeter against warpage and damage.

1. Glass-Fiber Board: Resin harden areas of core for attachment of mounting devices.

C. Fabric Facing: Stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other foreign matter. Applied with visible surfaces fully covered.

1. Where square corners are indicated, tailor corners.
2. Where radius or other nonsquare corners are indicated, attach facing material so there are no seams or gathering of material.
3. Where fabrics with directional or repeating patterns or directional weave are indicated, mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.

D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, substrates, blocking, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.

C. Match and level fabric pattern and grain among adjacent panels.

D. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch.
2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

3.3 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.

B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

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. Stained, architectural woodwork.
   b. Acoustical wall panels.
   c. Kitchen appliances.
   d. Elevator entrance doors and frames.
   e. Elevator equipment.
   f. Finished mechanical and electrical equipment.
   g. 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.
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

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 four unopened gallons 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-#): As selected by Architect.

D. VOC Content for Interior Paints and Coatings: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L (SCAQMD and CARB).
2. Nonflat Paints and Coatings: 50 g/L (SCAQMD) or 100 g/L (CARB).
3. Nonflat, High Gloss Paints and Coatings: 50 g/L (SCAQMD) or 150 g/L (CARB).
4. Dry-Fog Coatings: 50 g/L (SCAQMD) or 150 g/L (CARB).
5. Primers, Sealers, and Undercoaters: 100 g/L.
6. Anticorrosive and Antirust Paints Applied to Ferrous Metals (Industrial Maintenance and Rust Preventative Coatings): 100 g/L (SCAQMD) or 250 g/L (CARB).
7. Zinc-Rich Industrial Maintenance Primers: 100 g/L (SCAQMD) or 340 g/L (CARB).
8. Pretreatment Wash Primers: 420 g/L.
9. Floor Coatings: 50 g/L (SCAQMD) or 100 g/L (CARB).
10. Shellacs, Clear: 730 g/L.
11. Shellacs, Pigmented: 550 g/L.
12. Clear Wood Finishes: 275 g/L.
13. Stains, Exterior: 100 g/L (SCAQMD) or 250 g/L (CARB).
14. Stains, Interior: 250 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.

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 white shellac or other 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 spar varnish.
    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 Concrete and Masonry (where indicated), Painted Finish:

a. One Coat:

1) Tnemec 156 Enviro-Crete at 6.0 to 10 mils DFT.
2) Liquid Plastics Acrylic at 8.0 to 10.0 mils DFT.
3) Dupont Tufcryl at 8.0 to 10.0 mils DFT.
4) RD Coatings Elasto-Flex at 6.0 to 10.0 mils DFT.

b. And One Coat:

1) Tnemec 156 Enviro-Crete at 8 to 10 mils DFT.
2) Liquid Plastics Acrylic at 8.0 to 10.0 mils DFT.
3) Dupont Tufcryl at 8.0 to 10.0 mils DFT.
4) RD Coatings Elasto-Flex at 6.0 to 10.0 mils DFT.

2. Exterior Previously Painted Concrete, Previous Painted Masonry, Glazed Brick, and Plaster (where indicated), Painted Finish:

a. One Coat:

1) Tnemec 151 Elast-Grip at 2.0 to 3.0 mils DFT.
2) Liquid Plastics Water Borne Penetrating Primer at 3.0 mils DFT.
3) Dupont Corlar 2.1 PRP at 1.0 to 2.0 mils DFT.
4) RD Coatings Multiprim at 1.5 to 2.0 mils DFT.

b. And Two Coats:

1) Tnemec 156 Enviro-Crete at 8 to 10 mils DFT.
2) Liquid Plastics Decadex at 10.0 to 12.0 mils DFT.
3) Dupont Tufcryl at 8.0 to 10.0 mils DFT.
4) RD Coatings Elasto-Flex at 6.0 to 8.0 mils DFT.

3. Exterior Galvanized Metal (not shop-finished under Section 051200 - STRUCTURAL STEEL FRAMING, Section 055000 - METAL FABRICATIONS, or Section 055100 - METAL STAIRS AND RAILINGS), Alliphatic Acrylic Polyurethane System:

a. Surface Preparation: SSPC-SP16 Brush-off Blast of Galvanized Steel.
b. One Coat:

1) Tnemec 66HS Hi-Build Epoxoline at 3.0 mils DFT.
2) PPG PMC Amerlock 400 Hi-Build Epoxy at 4.0-5.0 mils DFT.
3) Dupont 25P High Solids at 4.0 mils DFT.
4) International Intergard 475 HS at 5.0 to 10.0 mils DFT.

c. And One Coat:

1) Tnemec 73 Endura-Shield at 3.0 mils DFT.
2) PPG PMC Amercoat 450H Polyurethane at 3.0 mils DFT.
3) Dupont Imron 2.8 Urethane at 3.0 to 4.0 mils DFT.
4) International Interthane 990 HS at 3.0 to 4.0 mils DFT.

4. Exterior Ferrous Metal, Urethane System:

a. Surface Preparation: SSPC-SP6.
b. One Coat:

1) Tnemec 90G-1K97 at 3 mils DFT; shop applied under other Sections; use for touch up.
2) PPG PMC Amercoat 68 MCZ at 3 mils DFT; shop applied under other Sections; use for touch up.
3) Dupont Urethane Ganicin Zinc Rich Primer 80%zinc load at 3.0 mils DFT.
4) International Interzinc 315 at 2.0 to 3.0 mils DFT.

c. And One Coat:

1) Tnemec 66HS Hi-Build Epoxoline at 3.0 mils DFT.
2) PPG PMC Amerlock 400 Hi-Build Epoxy at 3.0 to 5.0 mils DFT.
3) Dupont 25P High Solids Epoxy at 4.0 to 6.0 mils DFT.
4) International Intergard 475 HS at 4.0 to 8.0 mils DFT.

d. And One Coat:

1) Tnemec 73 Endura-Shield at 3.0 mils DFT.
2) PPG PMC Amerlock 450H Polyurethane Topcoat at 3.0 mils DFT.
3) Dupont High Solids Imron Urethane at 4.0 mils DFT.
4) International Interthane 990 HS at 2.0 to 3.0 mils DFT.

5. Exterior Aluminum (where required), Painted Finish:

a. Surface Preparation: Pressure wash with Oakite and sand with 3M Scotch-Brite nylon pads.
b. One Coat:

1) Tnemec 66HS Hi-Build Epoxoline at 2.0 mils DFT.
2) PPG PMC Amerlock 400 Hi-Build Epoxy at 2.0 to 3.0 mils DFT.
3) Dupont 25P High Solids at 4.0 mils DFT.
4) International Intergard 475 HS at 5.0 to 10.0 mils DFT.

c. And One Coat:

1) Tnemec 73 Endura-Shield at 2.0 mils DFT.
2) PPG PMC Amercoat 450H Polyurethane at 3.0 mils DFT.
3) Dupont High Solids Imron 2.8 at 4.0 mils DFT.
4) International Interthane 990 HS at 3.0 to 4.0 mils DFT.

6. Exterior Existing Prepainted Steel, for Sandblasting and Painted Finish:

a. Surface Preparation- SSPC-SP 6 Commercial Blast Cleaning.
b. One Coat:

1) Tnemec 90-97 or 90G-1K97 at 3 to 3.5 mils DFT.

2) PPG PMC Amercoat 68 MCZ at 3.0 mils DFT.
3) Dupont Ganicin 80% Zinc load Zinc Rich Primer at 3.0 to 3.5 mils DFT.

c. And One Coat:

1) Tnemec 73 Endura-Shield at 3.0 to 4.0 mils DFT.
2) PPG PMC Amerlock 400 at 4.0 DFT.
3) Dupont Imron 2.8 at 4.0 to 5.0 mils DFT.

d. And One Coat:

1) Tnemec 1070, 1071, or 1072 Flouronar at 2.5 to 3.5 mils DFT.
2) PPG PMC Corolon Coating at 5.0 mils DFT.
3) Dupont Flouropolymer at 3.0 mils DFT.

7. Exterior Existing Prepainted Steel, for Overcoat Painted Finish:

a. Surface Preparation: Water Blast 5000 psi and SSPC-SP3 Power Tool Clean.
b. One Coat:

1) Tnemec 394 Omnithane at 3.0 to 3.5 mils DFT.
2) PPG PMC Amerlock 400 Hi-Build Epoxy at 3.0 to 4.0 mils DFT.
3) RD Coatings Elasto Metal at 3.0 mils DFT.
4) International Interplus 356 at 3.0 to 5.0 mils DFT.

c. And One Coat:

1) Tnemec 66HS Hi-Build Epoxoline at 3.0 to 5.0 mils DFT.
2) PPG PMC Amerlock 400 at 3.0 to 4.0 mils DFT.
3) RD Coatings Elasto Metal at 7.0 mils DFT.
4) International Intergard 475 HS at 5.0 to 10.0 mils DFT.

d. And One Coat:

1) Tnemec 73 Endura-Shield at 3.0 to 5.0 mils DFT.
2) PPG PMC Amercoat 450H at 3.0 mils DFT.
3) RD Coatings MurCryl at 3.0 to 4.0 mils DFT.
4) International Interthane 990 HS at 3.0 to 4.0 mils DFT.

8. Exterior Wood, for Stained Finish:

a. Two Coats:

1) Cabot Water-Based Semi-Transparent Stain 1300.
2) Akzo Nobel Paints; Sikkens, approved equal.
3) Moore, approved equal.

C. Interior Paint Schedule, Typical:

1. Interior Gypsum Wallboard and Plaster, Latex Paint Finish:

a. One Coat, Primer:

1) Imperial Paints ECOS Interior Wall Primer.
2) Moore Ultra Spec 500 Interior Latex Primer 534.

3) PPG Speedhide Zero VOC Interior Primer 6-4900XI.
4) S-W Harmony Interior Primer B11 series.
5) S-W ProMar 200 HP Zero VOC Interior Primer.

b. And Two Coats, Flat Finish: At ceilings and elsewhere as indicated.

1) Imperial Paints ECOS Interior Flat.
2) Moore Ultra Spec 500 Interior Latex Flat 536.
3) PPG Speedhide Zero VOC Interior Latex Flat 6-4110XI.
4) S-W ProMar 400 HP Zero VOC Interior Flat.

c. And Two Coats, Eggshell Finish: At walls and elsewhere as indicated.

1) Imperial Paints ECOS Interior Eggshell.
2) Moore Ultra Spec 500 Interior Latex Low Sheen 537.
3) PPG Speedhide Zero VOC Interior Latex Eggshell 6-4310XI.
4) S-W ProMar 200 HP Zero VOC Interior Eg-Shel.

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) Imperial Paints ECOS Interior Wood Primer.
2) Moore Ultra Spec 500 Interior Latex Primer 534.
3) PPG Speedhide Zero VOC Interior Primer 6-4900XI.
4) S-W ProMar 200 HP Zero VOC Interior Primer.

b. And Two Coats, Semi-Gloss:

1) Imperial Paints ECOS Interior Satin.
2) Moore Ultra Spec 500 Interior Latex Semi-Gloss 539.
3) PPG Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
4) 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 Woodshield Varnish.Moore Benwood Stays Clear Acrylic Polyurethane Low Lustre W423.
4) 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 Speedhide Interior Masonry Hi Fill Latex Block Filler 6-15XI.
3) 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 Low Sheen 537.
2) PPG Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
3) S-W ProMar 200 HP Zero VOC Interior Eg-Shel.

5. Interior Concrete, Latex Paint Finish:

a. One Coat, Primer:

1) Moore Ultra Spec Masonry Int/Ext 100% Acrylic Sealer
2) PPG Perma-Crete Acrylic Primer
3) Loxon Masonry Coating

b. And Two Coats, Eggshell Finish: At ceilings, walls and elsewhere as indicated.

1) Moore Ultra Spec 500 Interior Latex Low Sheen 537.
2) PPG Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
3) S-W ProMar 200 HP Zero VOC Interior Eg-Shel

6. Interior Exposed Steel, Joists, Ductwork, Tectum Roof panel, Conduit and Similar Items (where indicated), 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 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. Interior Paint Schedule, High Performance and Specialty Systems:

1. Interior Gypsum Wallboard and Plaster at Toilet Rooms, and Other Wet Areas, Urethane Coating:

a. Surface Preparation: Cured, clean and dry, free of surface contaminants.
b. One Coat:

1) Tnemec 201 Epoxoprime at 3.0- 4.0 mils DFT.
2) PPG PMC Amerlock Sealer at 3.0 to 4.5 mils DFT.
3) Dupont Hi-Solids Colar primer at 3.0 to 4.0 mils DFT.
4) International Interseal 670 HS at 3.0 to 4.0 mils DFT.

c. And One Coat:

1) Tnemec 280 Tneme-glaze at 6.0 to 8.0 mils DFT.
2) PPG PMC Amercoat 351 Epoxy at 6.0 to 8.0 mils DFT.
3) Dupont 100 % Solids Epoxy at 8.0-10.0 mils.
4) International Interseal 670 HS at 3.0 to 4.0 mils DFT.

d. And One Coat:

1) Tnemec 1080 or 1081 Endurashield WB at 3.0 to 3.5 mils DFT.
2) PPG PMC AmerShield VOC at 2.0 to 3.0 mils DFT.
3) Dupont WB Urethane at 3.5 to 4.0 mils DFT.
4) International Water Borne Urethane at 3.0 to 4.0 mils DFT.

2. Interior Metals (Not specified to receive other coating systems/not shop finished), Epoxy Painted Finish:

a. One Coat: Approved primer, in shop under other Sections (where specified). If not shop primed, provide primer recommended by finish coating manufacturer.
b. And One Coat:

1) Tnemec 1029 Enduratone at 2.0 mils DFT.
2) PPG PMC Amerlock 400 at 2.0 to 4.0 mils DFT.
3) Dupont 25P at 3.0 to 4.0 mils DFT.
4) International Interseal 670 HS at 3.0 mils DFT.

c. And One Coat:

1) Tnemec 1029 Enduratone at 2.0 to 3.0 mils DFT.
2) PPG PMC Amerlock 400 at 2.0 to 4.0 mils DFT.
3) Dupont High Solids Acrylic Coating 3.0 mils DFT.
4) International Intercryl 530 at 3.0 to 4.0 mils DFT.

E. 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.
2. Tackboards.
3. Marker wall coverings.

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.
2. Fabric swatches fabric-faced tack assemblies.

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. Porcelain-Enamel Markerboard Assembly: Balanced, high-pressure, factory-laminated markerboard assembly of 3-ply construction consisting of backing sheet, core material, and 0.021-inch-thick, porcelain-enamel face sheet.

1. Available Manufacturers:

a. AACRO Products, Inc.
b. Claridge Products & Equipment, Inc.
c. Peter Pepper Products.
d. MooreCo; Best-Rite Manufacturing.
e. Steelcase Company; PolyVision products.

2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing with binder containing no added urea formaldehyde.
3. Fire Rating: ASTM E 84, Class A.
4. Color: White, low gloss finish.
5. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

B. Glass Markerboards: 6-mm tempered glass 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: Round, stainless-steel standoffs, holding glass approximately 1 inch from wall surface; mounted in notches in standoffs at top and bottom edges of markerboard.
3. Color and Surface: As selected by the Architect.
4. Marker Tray: Glass, supported by stainless-steel clips.

2.2 TACKBOARD ASSEMBLIES

A. Linoleum Resilient Tackboard: Uni-color linoleum resilient homogeneous tackable surface consisting of linseed oil, granulated cork, rosin binders and dry pigments calendared onto a natural burlap backing with integral color throughout with surface-burning characteristics indicated.

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. Forbo Industries; Bulletin Board.
    b. WallTalkers; Tac-wall.

2. Thickness: 1/4 inch.
3. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard backing with binder containing no added urea formaldehyde.
4. Fire Rating: ASTM E 84, Class A.
5. Colors: Refer to Finish Schedule.

B. Fabric-Wrapped Tackboard:

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. Claridge Products & Equipment, Inc.
    b. Egan Visual Inc.
    c. MooreCo; Best-Rite Manufacturing.
    d. Peter Pepper Products.
    e. Steelcase Company.

2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard backing with binder containing no added urea formaldehyde.
3. Fire Rating: ASTM E 84, Class A.
4. Fabric Facing Material, Colors and Patterns: Refer to Finish Schedule.

2.3 VISUAL DISPLAY WALL COVERINGS

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. Best-Rite Manufacturing.
2. Egan Visual Inc.
3. Marsh Industries, Inc.; Visual Products Group.
4. Omnova Solutions Inc.; Decorative Products; Commercial Wallcovering.
5. WallTalkers; a division of RJF International Corporation.

B. Visual Display Wall Covering: Intended for use with dry-erase markers and as a projection surface and consisting of moderate-gloss, plastic film bonded to fabric backing; not less than 0.020-mil total thickness.

1. Surface Graphics: 2-inch-square grid.
2. Color: As selected by Architect from manufacturer's full range.

C. Magnetic Visual Display Wall Covering: Intended for use with dry-erase markers and magnetic aids and consisting of moderate-gloss plastic film bonded to ferrous-powdered fabric backing; not less than 0.025-mil total thickness.

1. Color: As selected by Architect from manufacturer's full range.

D. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 099000 - PAINTING AND COATING and recommended in writing by wall covering manufacturer for intended substrate.

2.4 ACCESSORIES

A. Aluminum Frames and Trim: Factory-applied, fabricated from not less than 0.062-inch-thick, extruded aluminum; of size and shape indicated.

1. Chalk/Marker Tray: Manufacturer's standard, continuous tray.

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).

2.5 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.

2.6 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, or if not indicated, at heights indicated below. 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 10 14 00

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: Fabrication and installation of signage, including sub-framing, connections, anchors, fasteners, reinforcing, and all other items necessary to complete the work of this Section, including but not limited to the following types:

1. Fire, life safety and accessibility signage including but not limited to toilet room signage, classroom signage, mechanical and electrical room signage, stair signage.
2. Exterior building signage
3. Evacuation Maps

B. Design Requirements:

1. Engineering – Fabricator shall be responsible for the structural engineering of the signs including all components and fasteners.
2. Sign Layouts – A typical layout for each sign type will be provided by the Designer. Sign Fabricator is responsible for the layout and/or typesetting of each individual sign. Refer to Sign Message Schedule for copy (10 14 01).
3. Evacuation Maps – Designer will provide a typical layout for evacuation maps which shall be used to produce final artwork for each evacuation map for each location. Fabricator shall be responsible for producing artwork for each individual map including accurately locating fire alarms, fire extinguishers, and exit routes. Floor plans shall be rotated to correspond to each map location. Fabricator shall make revisions to the evacuation maps, as required, until approval is received by Owner/Designer.
4. Paper Inserts – Fabricator is responsible for printing and installing all paper inserts.
5. Revisions – Fabricator shall expect revisions to the message schedule and sign layouts throughout the project and incorporate revisions as required.
6. Coordination – Fabricator is responsible for coordinating with other trades affected by work to assure performance in proper sequence. Furnish setting templates, layouts, anchors, fasteners, and built-in items as required to cause no delays.
7. Approvals – Prior to fabrication, Fabricator shall coordinate and obtain required approvals for Fire/Life Safety/ADA and any related regulatory signage. Fabricator shall temporarily post full size color prints of each code sign in its specified location for review with Code Officials to gain approval.

C. 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. Project Schedule: Upon project Notice to Proceed, Fabricator and Installer shall submit a detailed project schedule for review by the Designer. Schedule shall indicate proposed dates for start and completion of work, also indicating installation on each floor as applicable. Modify project schedule if required for proper sequencing with other trades or for completion of overall project.

B. Timing of Submittals: Allow a minimum of 10 working days for Designer's response to submittals.

C. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in the sign schedule.

E. Shop Drawings:

1. Shop drawings shall indicate component details, general arrangement, methods of anchoring, finishing details, and other pertinent information. Drawings shall include anchors, grounds, reinforcements, accessories, layouts, and installation details.

2. Fabricator is to verify field conditions at sign locations and take field measurements prior to preparation of shop drawings.
3. Prepare details at not less than 3" = 1'-0" scale.
4. Show message list, typestyles, graphic elements, and layout for each sign.
5. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
6. For signage supported by or anchored to permanent construction or existing building, provide setting drawings, templates, and directions for installation of anchor and other fasteners to be installed as a unit of Work in other Sections.
7. Include internal structure, dimensions, and specifications for all items.
8. Delegated design submittals shall be signed by the qualified professional engineer responsible for their preparation.
9. Shop drawings shall be project specific. Shop drawings which are simply copies of the design drawings are not acceptable.

F. Samples and Prototypes:

1. Full size sample of each type of panel sign
2. Full size, fully fabricated dimensional letter for exterior signage
3. Full size, fully fabricated dimensional letter for interior dimensional letters
4. After initial materials review, fabricate prototypes from approved materials samples to be fully assembled to replicate the final sign as close as possible. Include applicable attachment devices.
5. Unless noted in Design Intent drawings, approved samples will not be returned for installation into Project.

G. Paper Mock-Up(s): Prior to installation, provide full size paper mock-ups for each sign. Temporarily mount paper mock-ups on site in location indicated for review and approval by Designer. Fabricator to obtain Owner/Designer's acceptance of mock-ups prior to start of installation. Modify mock-ups as directed until acceptance is given.

H. Sustainable Design: Documentation required to indicate compliance with sustainable design certification required for the project, for low-VOC coatings which are field applied.

I. Permits: Copies of permits for signage and signage installation as required by authorities having jurisdiction.

J. Fabricator Qualifications: Name and contact information for fabricator's proposed for use, including list of project experience. The Owner reserves the right to reject fabricators which the Owner determines to be unacceptable.

K. Installer Qualifications: Name and contact information for installer's proposed for use, including list of project experience. The Owner reserves the right to reject installers which the Owner determines to be unacceptable.

L. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

M. Maintenance Materials:

1. For signage attachment, one set of tools for dismounting or adjusting signage. For field applied coatings, 1 unopened gallon of each color and type.
2. Submit complete lamp replacement information, including brand, type, wattage, color and similar items for all lamps.

N. Punch List: At Substantial Completion, indicating work remaining or damaged work which has not been repaired or replaced. Refer to additional requirements specified at the end of this Section.

O. Copyright Acknowledgement: Letter signed by fabricator acknowledging Arrowstreet copyright for custom signage design.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

B. Fabricator Qualifications: Minimum 2 years experience fabricating similar signage and with sufficient resources to meet the schedule requirements for the Project.

C. Installer Qualifications: Acceptable to Fabricator, and with a minimum 2 years experience installing similar signage and with sufficient resources to meet the schedule requirements for the Project.

D. Accessibility Requirements: Comply with local accessibility regulations and requirements and with Americans with Disabilities Act (ADA).

E. Regulatory Requirements: Obtain and pay for permits for installing signage as applicable to the location of the Project. Notify the Owner and Designer in writing if signage does not comply with applicable requirements prior to fabrication of signage.

F. Delegated Structural Design: Engage a qualified professional engineer, to design sign structure and anchorage. Details on Drawings indicate a design approach for sign fabrication.

1. The Drawings do not necessarily include all fabricating details required for the complete structural integrity of the signs, including consideration for static, dynamic, and erection

loads during handling, erecting, and service at the installed locations, nor do they necessarily consider the preferred shop practices of the individual Sign Fabricators. Therefore, it shall be the responsibility of the Fabricator's engineer to perform the complete structural design of the signs and to incorporate all the reasonable safety factors.

2. Submit calculations signed and sealed by a registered professional engineer current licensed in the Commonwealth of Massachusetts, and as indicated in Par. 1.2. Include statement indicating exterior signage meets or exceeds code requirements for wind and seismic loads.

G. Designer's and Owner's Response to Submittals: The scope of the Designer's review is to check for general conformance with the design concept of the project and general compliance with Contract Documents only. No responsibility is assumed by Designer for accuracy of dimensions, details, quantities, or procedures shown on shop drawings or submittals.

1. Omission in shop drawings of items, materials, or processes indicated in Contract Drawings or Specifications, or otherwise required for proper execution and completion of work, does not relieve the Fabricator from responsibility for providing such items, materials, or processes. Fabricator is responsible for accuracy, dimensions, quantities, strength of connection, coordination with various trades, and conformance to project requirements and all applicable codes.
2. Approval of a separate or specified item does not necessarily constitute approval of an assembly in which item functions.

H. Copyright Acknowledgment: Custom signage is designed and copyrighted by Arrowstreet solely for use on this project. Drawings and specifications and designs incorporated herein are instruments of professional service and shall not be used, in whole or in part, for any other project. Submit letter signed by authorized representative acknowledging copyright on signage and concepts for this project, and agreeing not to violate the terms of the copyright. Copyright restrictions include, but are not limited to, the following:

1. Re-use or duplication of signage concepts and Drawings prepared by Arrowstreet is prohibited.
2. Distribution in hardcopy or electronic methods or on the internet is prohibited.
3. Display in printed or on-line catalogs without prior written permission of Arrowstreet is prohibited.

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.

B. If finished field conditions do not match those illustrated in design intent documents and adversely affect the execution of the finished design, Fabricator shall bring to the attention of the Designer. Designer and Fabricator shall work together to determine acceptable alterations to design to accommodate field conditions.

1.6 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard limited 2 year warranty agreeing to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following: Deterioration of finishes beyond normal weathering; fading, distortion or oil-canning; deterioration of embedded graphic image; separation or delamination of sheet materials and components.

PART 2 - PRODUCTS

2.1 SIGNAGE

A. Schedule of Sign Types: Refer to the attachments to this Section and the Drawings.

2.2 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. Type: Photopolymer on acrylic or printed acrylic / aluminum as applicable.
2. Color: Custom color as selected.
3. Type Size: As selected.
4. Typeface: As selected.

2.3 MATERIALS, GENERAL

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

D. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.

E. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.

F. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.

G. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.

3. Exposed Metal-Fastener Components, General:

   a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   b. Fastener Heads: For nonstructural connections, use screws and bolts with tamper-resistant slots unless otherwise indicated.

4. Sign Mounting Fasteners:

   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
   b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
   c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

5. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

B. Adhesive: As recommended by sign manufacturer. Provide optically clear adhesive when bonding to glass.

C. Pressure Sensitive Tape: Very High Bond (VHB), double-faced tape, guaranteed not to delaminate under conditions of use indicated. Provide optically clear tape when bonding to glass.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

A. Software: Contractor shall provide software and computer programs as required to create signage and images indicated on the Drawings, including large scale formats.

B. Typesetting: Typeset messages shall be prepared on computer. Letterforms shall match samples shown on the Drawings. Output for photographic reproduction shall be 2400 dpi. No typesetters' proofs shall be enlarged more than three times for use as graphics. Letter spacing and word spacing shall be approved for all layouts before final manufacture. Typical type and symbol layout for each sign type is indicated on the Drawings. Type shall be placed according to the dimensions and spacing shown on the Drawings. Should any design conflict occur in the fabrication of the signs, such as non-fitting messages, it shall be brought to the attention of the designer for resolution before manufacturing.

C. Appearance: Names, stamps, and decals of manufacturer, installer or those maintaining signs shall not appear in the finish work

D. 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. Raised-copy thickness, not less than 1/32 inch.

E. Symbols of Accessibility: Provide symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.

F. 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.

G. Additional Fabrication Requirements: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and water retention.
3. Materials shall be a single piece for each location whenever possible. If design material limitations require seaming or jointing, locate joints or seams on shop drawings for review by Designer.
4. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces. All welds to be ground smooth and finished flush, free of weld marks, and polished. Welding on finish surfaces shall be indistinguishable from parent material.
5. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
6. Internally brace signs for stability and for securing fasteners. Provide sufficient fasteners and anchors to preclude loose installation, racking or movement over time
7. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
8. Acrylic: Flame polish all returns, saw marks not permitted.

H. Masked and Sprayed Graphics: Spray graphics onto face of panel and/or building substrate using computer-cut stencils to mask background.

1. Graphics shall have sheen as surrounding material and shall be indistinguishable in finish from surrounding material.
2. Execute sprayed graphics so that edges and corners of finish letterforms and graphic devices are true and clean. Any rounded positive or negative corners, edge build up, bleeding, or any other imperfections will be rejected.
3. Sprayed graphics to be 100% opaque and evenly applied without pin holes, scratches, orange peeling, or application marks. Spraying with any show through of background colors will not be accepted.

I. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

2.6 FINISHES, GENERAL

A. Finishes: Refer to finish requirements specified with sign type.

B. Protective Covering: 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.

2.7 PAINTED FINISHES

A. The term “paint” refers to those materials that require a finished surface as recommended by the approved materials manufacturer. “Paint” includes preparation, priming/sealing, and intermediate and finish coats as applicable.

B. Paint:

1. Provide an alphatic polyurethane enamel with ultraviolet inhibitors, and lightfast, weather, abrasion and wear resistant additives.
2. Compile and maintain a listing of all colors with the factory batch number and formulation code for all paints and coatings. At the date of substantial completion, submit the list to the Owner for future maintenance reference.

C. Application and Finish:

1. Coatings shall be applied by an applicator having facilities, equipment, and experience required to apply the finish to the manufacturer’s specifications. All substrates shall be cleansed of any foreign substance such as oil, grease, dirt, etc. Typical finish shall consist of:

a. An acid-wash prime coat applied per manufacturer’s specifications when using raw metal as a substrate.
b. Primer/filler seal coat, properly applied to all substrates per manufacturer’s specifications including dry film thickness.
c. Primer/filler coat sanded smooth before topcoating and coated with a minimum of two applications of acrylic polyurethanes in colors indicated on the design drawings. Top coating shall be applied per manufacturer’s recommendations to a minimum total dry film thickness of 2.0 mil.

2. Coating Performance Criteria:

a. Dry film thickness: Within minus 5% to plus 25% of the specified thickness.
b. Abrasion resistance: ASTM D968 coefficient of abrasion 65 minimum.
c. Pencil hardness: 2H minimum.
d. Salt spray: ASTM B-117 withstanding 3500 hours, 100% salt fog at 95 degrees F and retaining adhesion, corrosion resistance, color, and gloss with no more than minimal blisters no larger than No. 8 (ASTM D-714), and no more than 1/16” creep or loss of adhesion from scribed line.
e. Humidity test: ASTM D-2247 withstanding 3500 hours 100% relative humidity at 95 to 100 degrees F and retaining adhesion, corrosion resistance, color, and gloss with no more than minimal blisters no larger than No. 8 (ASTM D-714), and no more than 1/16” creep or loss of adhesion from scribed line.
f. Gloss: ASTM D523, +/-5%, using a 60 degree glossmeter, of the gloss level selected by the Designer.
g. Adhesion: No removal of any finish after 1/16” crosshatching to base metal, impacting to the point of metal rupture, and subjected to application and quick removal of cellophane tape.

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 signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
5. Provide temporary protective covers until Substantial Completion of the project.

B. Tolerances: The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Document and shall not be added to allowable tolerances indicated for other Work:

1. Allowable Variation from True Plumb, Level and Line: Plus or minus 1/16 inch.
2. Allowable Variation from Adjacent Surfaces Intended to Be Flush: 1/32 inch.

C. Mounting Methods: Use mounting methods suitable for substrate and project conditions.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 PUNCH LIST

A. When Installer considers the work has reached final completion (when less than one percent of the Contract remains to be completed), submit written notice, together with a written list (punch list) of items to be completed or corrected.

B. The Designer will review the punch list and add additional items after inspection on the jobsite. The Installer shall meet with the Designer to confirm the punch list items, and respond to questions regarding the work which must be done before final acceptance. The Installer shall correct punch list items within an Owner-approved time frame established when the punch list is submitted. The time frame for completion of the punch list items shall not exceed the completion date of the Contract. The Contract shall not be considered complete until punch list items are completed.

3.4 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

Sign #		Type	Room Number	Door Number	Layout	Mtg Elev	Mtg Detail	Message	Notes
LL.01	-	**A1**			A1.1/ AG7.01	A1.1/ AG7.01	A1.2/ AG7.01	NEWTON EARLY CHILDHOOD PROGRAM	
LL-02	-	**B1**			B1.1/ AG7.01	B1.1/ AG7.01	B1.2/ AG7.01		
LL.03	-	**C1**			C1.1/ AG7.02	C.2/ AG7.02	C.5/ AG7.02	(STAIR) STAIR 3	Previously Stair 1
LL.04	-	**C6**			C6.2/ AG7.02	C.2/ AG7.02	C.5/ AG7.02	LL LOWER LEVEL	
LL.05		**D1**			D1.1/ AG7.02	D1.3/ AG7.02	D1.2/ AG7.02	(See Layout)	Designer to Supply Artwork
LL.06		**D3**			D3.1/ AG7.02	D3.2/ AG7.02	D1.2/ AG7.02	TRAINING STAIRS NOT AN EXIT	
LL.07		**D3**			D3.1/ AG7.02	D3.2/ AG7.02	D1.2/ AG7.02	TRAINING STAIRS NOT AN EXIT	
1.01	-	**C2**			C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	106	Mounted at hallway entrance to suite of rooms
1.02	-	**C1**			C1.1/ AG7.02	C.2/ AG7.02	C.5/ AG7.02	(STAIR) STAIR 3	Previously Stair 1
1.03	-	**C6**			C6.1/ AG7.02	C.2/ AG7.02	C.5/ AG7.02	1 LEVEL 1	
1.04	-	**C6**			C6.1/ AG7.02	C.3/ AG7.02	C.5/ AG7.02	1 LEVEL 1	
1.05	-	**C1**			C1.1/ AG7.02	C.3/ AG7.02	C.5/ AG7.02	(STAIR) STAIR 1	Prevously Stair 2
1.06	-	**D1**			D1.1/ AG7.02	D1.3/ AG7.02	D1.2/ AG7.02	(See Layout)	Designer to Supply Artwork
2.01	-	**C1**			C1.1/ AG7.02	C.3/ AG7.02	C.5/ AG7.02	(STAIR) STAIR 3	Previously Stair 1
2.02	-	**C6**			C6.1/ AG7.02	C.2/ AG7.02	C.5/ AG7.02	2 LEVEL 2	
2.03	-	**C6**			C6.1/ AG7.02	C.2/ AG7.02	C.5/ AG7.02	2 LEVEL 2	
2.04	-	**C1**			C1.1/ AG7.02	C.3/ AG7.02	C.5/ AG7.02	(STAIR) STAIR 1	Previously Stair 2
2.05	-	**D1**			D1.1/ AG7.02	D1.3/ AG7.02	D1.2/ AG7.02	(See Layout)	Designer to Supply Artwork
CODE ROOM SIGNS									
		C3	006	006	C7.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	MEETING ROOM 2	
		C7	007		C7.1/ AG7.02	C.4/ AG7.02	C.6/ AG7.02	RECEPTION VISITORS PLEASE CHECK IN HERE	
		C4	007A	007A	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization

Sign #	Type	Room Number	Door Number	Layout	Mtg Elev	Mtg Detail	Message	Notes
	C4	007B	007B	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C4	009	009B	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C3	009A	009A	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	RECORDS	
	C3	005	005	C3.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	MEETING ROOM 1	
	C3	008	008	C3.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	MEETING ROOM 3	
	C4	004	004	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C3	013	013	C3.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	P.E.	PE/Multi-Purpose Space
	C3	014	014	C3.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	CLASSROOM	PT
	C3	011	011	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C1	003	003	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) ADULT TOILET	
	C1	002	002	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C3	012	012	C3.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	CLASSROOM	OT
	C5	015	015	C5.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	M.E.P. NO STORAGE ALLOWED 015	
	C5	015A	015A	C5.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	MAIN ELECTRICAL NO STORAGE ALLOWED 015A	
	C3	001	001	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C3	001	001A	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C3	001	001B	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C3	001	001C	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C3	010	010	C3.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STAFF LUNCH ROOM	

Sign #	Type	Room Number	Door Number	Layout	Mtg Elev	Mtg Detail	Message	Notes
	C3	010A	010A	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C2	106	106	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	106	Classroom
	C1	107	107A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C1	107	107	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C3	115B	EX015B	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	CUSTODIAN	Exterior Grade
	C2	106B	106B	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	106B	Mindful Room
	C2	106A	106A	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	106A	Small Group
	C2	105	105	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	105	Classroom
	C1	105A	105A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C4	104	104	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C2	103	103	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	103	Classroom
	C1	103B	103B	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C2	108	108	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	108	Classroom
	C1	108A	108A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C3	108B	108B	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C3	108B	108C	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	STORAGE	
	C2	102	102	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	102	Work Space
	C4	102G	102G	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C4	102C	102C	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C4	102A	102A	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C3	102B	102B	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	B.D.A.	

Sign #	Type	Room Number	Door Number	Layout	Mtg Elev	Mtg Detail	Message	Notes
	C4	102D	102D	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C1	102E	102E	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C5	102F	102F	C5.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	TEL/DATA NO STORAGE ALLOWED 102F	
	C1	101	101	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) ADULT TOILET	
	C2	201	201	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	201	Classroom
	C2	202	202	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	202	Wellness
	C2	203	203	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	203	Classroom
	C1	201A	203C	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C1	201A	201A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C2	204	204	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	204	Classroom
	C2	206	206	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	206	Classroom
	C1	204A	204A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C1	204A	206B	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C5	205	205	C5.2/ AG7.02	C.2/ AG7.02	C.5/ AG7.02	ELEVATOR MACHINE ROOM NO STORAGE ALLOWED 205	
	C2	207	207	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	207	Classroom
	C2	208	208	C2.1/ AG7.01	C.1/ AG7.02	C.4/ AG7.02	208	Classroom
	C1	207A	207A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	

Sign #	Type	Room Number	Door Number	Layout	Mtg Elev	Mtg Detail	Message	Notes
	C1	207A	208C	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C2	209	209	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	209	Classroom
	C2	211	211	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	211	Classroom
	C1	209A	209A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C1	209A	211A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C2	210	210	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	210	Mindful Room
	C2	212	212	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	212	Small Group
	C2	216	216	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	216	Wellness
	C1	214	214	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) ADULT TOILET	
	C1	215	215	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) ADULT TOILET	
	C3	213	213	C3.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	CUSTODIAL CLOSET	
	C2	217	217	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	217	Small Group Classroom
	C2	218	218	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	218	Classroom
	C1	218A	218A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C1	218A	219B	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C2	219	219	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	219	Classroom
	C2	220	220	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	220	Classroom
	C1	220A	220A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C1	220A	221B	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C2	221	221	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	221	Classroom

Sign #	Type	Room Number	Door Number	Layout	Mtg Elev	Mtg Detail	Message	Notes
	C2	222	222	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	222	Classroom
	C1	222A	222A	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) STUDENT TOILET	
	C2	226	226	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	226	Small Group
	C2	223	223	C2.1/ AG7.01	C.1/ AG7.02	C.5/ AG7.02	223	Wellness
	C4	224	224	C4.1/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	OFFICE	Includes Panel for Customization
	C1	225	225	C1.2/ AG7.02	C.1/ AG7.02	C.5/ AG7.02	(TOILET) ADULT TOILET	

END OF SECTION

SECTION 102120

CUBICLES

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. Curtain tracks and curtain carriers.
2. Cubicle curtains.

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 for mounting items requiring anchorage.

1.3 PERFORMANCE REQUIREMENTS

A. Curtains: Provide curtain fabrics with the following characteristics:

1. Fabrics are launderable to a temperature of not less than 160 deg F.
2. Fabrics are flame resistant and are identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.

a. Identify fabrics with appropriate markings of applicable testing and inspecting agency.

1.4 SUBMITTALS

A. Product Data: Include durability, laundry temperature limits, fade resistance, and fire-test-response characteristics for each type of curtain fabric indicated.

1. Include data on each type of applied curtain treatment.

B. Shop Drawings: Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.

1. Include details on blocking.

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. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

D. Samples for Initial Selection: For each type of curtain material indicated.

E. Samples for Verification: For each type of product required, prepared on Samples of size indicated below.

1. Curtain Fabric: 12-inch-square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
2. Mesh Top: Not less than 4 inches square.
3. Curtain Track: Not less than 4 inches long.
4. Curtain Carrier: Full-size unit.

F. Curtain and Track Schedule: Use same designations indicated on Drawings.

G. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.

H. Operation and Maintenance Data: For curtains, track, and hardware to include in operation and maintenance manuals.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install cubicles 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.

PART 2 - PRODUCTS

2.1 CURTAIN TRACKS

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. Crowder, K. N. Manufacturing, Inc.
2. General Cubicle Company, Inc.
3. InPro Corporation.
4. Nelson, A. R. Co.
5. Silent Gliss USA Inc.

B. Extruded-Aluminum Track: Not less than 1-1/4 inches wide by 3/4 inch high; with minimum wall thickness of 0.062 inch.

1. Finish: Satin anodized.

C. Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

D. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.

E. Exposed Fasteners: Stainless steel.

F. Concealed Fasteners: Stainless steel.

2.2 CURTAINS

A. Cubicle Curtain Fabric: Curtain manufacturer's standard, 100 percent polyester, inherently and permanently flame resistant, stain resistant, and antimicrobial.

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. KoSa; Avora FR.
b. Trevira, R-M Schulz Consulting, Inc.; Trevira CS.

2. Pattern: As selected by the Architect.
3. Color: As selected by Architect.

B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

C. Mesh Top: No. [50] [40] [42] nylon mesh.

D. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.3 CURTAIN FABRICATION

A. Fabricate curtains to comply with the following requirements:

1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches added fullness.
2. Length: Equal to floor-to-ceiling height, with 20-inch mesh top, and minus distance above the finished floor at bottom as follows:

a. Cubicle Curtains: 12 inches.

B. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

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 work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install tracks level and plumb, according to manufacturer's written instructions.

B. Provide track fabricated from 1 continuous length.

1. Curtain Track Mounting: As indicated on Drawings.

C. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

1. Provide one locking switch unit for each pair of beds.
2. Provide one hinged loading unit for each bed.

D. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.

E. Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

3.3 PROTECTION

A. Protect installed recessed track openings with nonresidue adhesive tape to prevent construction debris from impeding carrier operation. Remove tape prior to Substantial Completion.

END OF SECTION

SECTION 102219

DEMOUNTABLE PARTITIONS

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. Site-assembled demountable partitions.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood blocking and nailers.
2. Section 087111 - DOOR HARDWARE for door hardware.
3. Section 088000 - GLAZING for glass and glazing requirements.
4. Division 26 - ELECTRICAL for power and wiring requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide demountable partitions capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Load-Bearing Capacity: Not less than 7 lbs. / linear inch distributed proof load when tested according to BIFMA X 5.6.
2. Transverse-Load Capacity: Lateral deflection of not more than 1/240 of the overall span when tested under a uniformly distributed load of 5 lb/sq. ft. according to ASTM E 72.

B. Seismic Performance: Provide demountable partitions capable of withstanding the effects of earthquake motions determined according to Code requirements.

C. Acoustical Performance: Where acoustical rating is indicated, provide demountable-partition assembly tested by a qualified testing agency for sound transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For demountable partitions.

1. Include plans, elevations, and sections; attachment details at floors, columns, permanent partitions, and ceilings; and method of erection and disassembly.

2. Include diagrams for power-, signal-, and control-wiring raceways; and details of access to raceways.

C. Samples: For each exposed product and for each color and texture specified, 6 inches square in size.

D. Samples for Verification: For each type of the following products:

1. Face-Panel Finish: Manufacturer's standard-size unit, but not less than 6 inches square.
2. Linear Trim: 12-inch-long Samples.
3. Door Finish: Manufacturer's standard-size unit, but not less than 3 inches square.
4. Glazing: Manufacturer's standard-size unit, but not less than 3 inches square.
5. Hardware and Accessories: Whole units.

E. Product Certificates: For each type of demountable partition.

F. Product Test Reports: For each type of demountable-partition assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Maintenance Data: For demountable partitions to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing 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.

C. Safety Glazing Products: Comply with requirements of Section 088000 - GLAZING.

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for demountable partitions including accessories.

a. Size: 48 inches by full height.
b. Each type of exposed construction.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Designer specifically approves such deviations in writing.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 FIELD CONDITIONS

A. Finished Spaces: Do not deliver or install demountable partitions until finishes in spaces to receive them are complete, including suspended ceilings, floors, carpeting, and painting.

B. Field Measurements: Indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SITE-ASSEMBLED DEMOUNTABLE PARTITIONS

A. General: Site-assembled, demountable-partition assembly and components that are the standard products of manufacturer.

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. DIRTT Environmental Solutions.
b. Herman Miller Wall Alliance.
c. KI.
d. SmartWalls LLC.
e. ULTRAWALL LLC.

2. Basis of Design: KI; Genius Architectural Wall.

B. Acoustical Rating: STC 44 minimum.

C. Face Panels: Manufacturer's standard gypsum board.

1. Finish: As indicated on the Drawings.

D. Framing: Aluminum studs and top and bottom tracks, manufacturer's standard depth.

E. Trim: Continuous, factory-finished, snap-on type; adjustable for variations in floor and ceiling levels.

F. Doors: Manufacturer's standard 1-3/4-inch-thick, solid-core wood door construction.

1. Wood Veneer Species and Cuts: As indicated.

G. Door Frames: Manufacturer's standard aluminum frames for 1-3/4-inch doors, factory mortised to receive hardware.

H. Hardware: As specified in Section 087111 - DOOR HARDWARE.

I. Glazing Frames: Manufacturer's standard aluminum frames for glazing thickness indicated.

1. Frame Finish: Clear-anodized aluminum.

J. Glazing: As specified in Section 088000 - GLAZING.

K. Seals: Manufacturer's standard.

L. Electrical Devices: Integral, concealed raceways to serve electrical power and communication devices indicated on Drawings.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.

2.2 FABRICATION

A. General: Fabricate demountable walls for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate systems for installation with continuous seals at floor, ceiling, and other locations where partitions abut fixed construction.

B. Panels for Site-Assembled Demountable Partitions: Face panels fabricated and finished in modular widths indicated.

1. Transom Panels: Fabricated in material and finish to match wall panels unless otherwise indicated.

C. Panels for Unitized-Panel Demountable Partitions: Factory-assembled, flush, unitized-panel construction; with faces smooth and free of buckles, oil canning, and seams; and insulated with solidly packed, inorganic, mineral filler.

1. Factory glaze panels to the greatest extent possible.

D. Finish Facings: Factory apply finish-facing materials with appropriate backings, using mildew-resistant nonstaining adhesive as recommended by finish-material manufacturer's written instructions.

E. Wiring: Conceal conductors and cables in raceways. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

2.3 MATERIALS

A. Wood Species and Cut for Transparent Finish: Bamboo, to match Section 064020 - INTERIOR ARCHITECTURAL WOODWORK.

B. Particleboard: ANSI A208.1, Grade M-2 with 45-lb density and exterior glue; made with adhesive containing no added urea formaldehyde.

1. Recycled Content of Particleboard: Provide products with recycled content.

C. Gypsum Board: ASTM C 1396/C 1396M.

D. Adhesives: As recommended by demountable-partition manufacturer.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. 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.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker clear anodic coating over a nonspecular as fabricated mechanical finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install demountable partitions after other finishing operations have been completed.

1. Install partitions rigid, level, plumb, and aligned. Install seals at connections with floors, ceilings, fixed walls, and abutting surfaces to prevent light and sound transmission.
2. Broken, cracked, chipped, deformed, or unmatched panels and components are not acceptable.
3. Except for filler panels scribed to fixed walls or columns, do not modify manufacturer's standard components.

B. Suspended-Ceiling System: Do not alter suspended-ceiling system.

C. Doors and Frames: Install door-and-frame and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

3.2 ERECTION TOLERANCES

A. Install each demountable partition so surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent partitions.

3.3 ADJUSTING

A. Inspect installation, correct misalignments, and tighten loose connections.

B. Adjust doors to operate smoothly and easily, without binding or warping.

C. Check and readjust operating hardware. Verify that latches and locks engage accurately and securely without forcing or binding; lubricate as recommended by manufacturer.

D. Clean soiled surfaces to remove dirt, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

E. Remove and replace defaced or damaged components that cannot be satisfactorily repaired.

F. Remove and replace components that are wet, moisture damaged, or mold damaged.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train User Agency’s maintenance personnel to adjust, operate, and maintain demountable partitions.

END OF SECTION

SECTION 102610

CORNER GUARDS

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.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain corner guards from single source from single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 - PRODUCTS

2.1 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. ARDEN Architectural Specialties, Inc.
    b. Balco, Inc.
    c. Construction Specialties, Inc.
    d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
    e. Nystrom Building Products.

2. Material: Stainless steel, Type 304.

    a. Thickness: Minimum 0.0781 inch.
    b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
4. Corner Radius: 1/8 inch.
5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.2 FABRICATION

A. Fabricate 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.

2.3 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, polished finish indicated, free of cross scratches.

1. Run grain of directionally textured finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

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 units 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. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install 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 corner guards.

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.

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 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 104100

EMERGENCY ACCESS AND INFORMATION CABINETS

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. Fire department key vault box.

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.
2. Section 061000 - ROUGH CARPENTRY for wood blocking.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each product and system used. Provide manufacturer's certifications stating that products and systems comply with requirements.

B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide plans, elevations, and details of anchorage, connections and accessory items. Provide installation templates for work installed by others.

C. Contractor's Review: Before commencing work, submit signed statement that Contract Documents have been reviewed with a qualified representative of supplier/manufacturer, and that selected materials and construction are proper, compatible, and adequate for application shown.

PART 2 - PRODUCTS

2.1 FIRE DEPARTMENT KEY VAULT BOX

A. Fire Department Key Vault Box: Provide at building entrance; location shall be acceptable to local Fire Department.

1. Basis of Design: Knox Company; Model 3200 Knox-Box, Recessed Mounted Type.
2. Finish: Weather resistant TGIC polyester powder coat, color as selected by local Fire Department.
3. Locking: Provide lock and keys acceptable to local Fire Department.
4. Building Alarm Interface: Provide tamper switch interface with building alarm system.

5. Accessories:

   a. Provide manufacturer's standard recessed mounting kit, for installation in specified construction.
   b. Provide alarm tamper switches, UL listed.

PART 3 - EXECUTION

3.1 INSPECTION

A. Rough-In Work: Examine installation of walls and other conditions under which work is to be installed; verify dimensions of services and substrates before fabricating work.

B. Notify Contractor of unsatisfactory locations and dimensions of other work and of unsatisfactory conditions for proper installation of equipment. Do not proceed with fabrication and installation until unsatisfactory dimensions and conditions have been corrected in manner satisfactory to Installer.

3.2 FIRE DEPARTMENT KNOX BOX INSTALLATION

A. General: Set each item of equipment securely in place, level, and adjust to correct height, 4 ft. - 0 in. AFF, unless otherwise required by local Fire Department.

B. Anchor to supporting substrate where indicated and where required for sustained operation and use without shifting or dislocation. Conceal anchorage where possible. Seal perimeter joints in accordance with Section 079200 - JOINT SEALANTS.

3.3 CLEANING

A. After completion of installation and other major work remove protective coverings, if any, and clean equipment, internally and externally. Restore exposed and semi-exposed finishes to remove abrasions and other damages; polish exposed-metal surfaces and touch-up painted surfaces. Replace work that cannot be successfully restored.

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: Enameled-steel sheet.

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. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

F. Door Material: Steel sheet with baked enamel finish, color as selected.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered break glass.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. 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. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet, or provide locking mechanism that allows for emergency access to the cabinet without the breaking of glass, simply by pulling sharply on the cabinet's handle.
3. 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. Provide inside latch and lock for break-glass panels.
3. 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 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. Switches: Provide mercury-free switches in appliances.

F. 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 APPLIANCES

A. Appliance Schedule: Refer to Drawings.

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.

1. Range Hood, Exhaust Fans, and Dryer Vents: Vent directly to the building exterior.

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 115210

PROJECTION SCREENS

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. Manually-operated projection screens.

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

1. Section 095100 - ACOUSTICAL CEILINGS for coordination with ceiling-recessed units.

1.3 SUBMITTALS

A. Product Data: For each type of screen indicated.

B. Shop Drawings: Show layouts and types of projection screens. Include the following:

1. Location of screen centerline relative to ends of screen case.
2. Location of seams in viewing surfaces.
3. Drop length.
4. Connections to supporting structure for pendant- and recess-mounted screens.
5. Anchorage details.
6. Details of juncture of exposed surfaces with adjacent finishes.
7. Frame details.
8. Accessories.

C. Maintenance Data: For projection screens to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

B. Store rear-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.6 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, and partitions.

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. Bretford Manufacturing, Inc.
2. Da-Lite Screen Co., Inc
3. Draper Inc.
4. Stewart Filmscreen.

B. Basis-of-Design:

2.2 FRONT-PROJECTION SCREENS

A. Manually Operated Screens: Manufacturer's standard spring-roller-operated units, consisting of case, screen, mounting accessories, and other components necessary for a complete installation.

1. Screen Mounting: Top edge securely anchored to a 3-inch-diameter, rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.

B. Screen Material and Viewing Surface:

1. Matte-White Viewing Surface: Peak gain of 0.9 to 1.0, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
2. Mildew Resistance: Rating of 0 or 1 when tested according to ASTM G 21.
3. Flame Resistance: Passes NFPA 701.
4. Seamless Construction: Provide screens, in sizes indicated, without seams.
5. Edge Treatment: Black masking borders.
6. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:
7. Size of Viewing Surface: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a

smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. Test manually operated units to verify that screen operating components are in optimum functioning condition.

3.2 PROTECTING AND CLEANING

A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 116620

ATHLETIC EQUIPMENT

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. Safety pads.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 033000 - CAST-IN-PLACE CONCRETE for installation of floor insert sleeves to be cast in concrete slabs and footings.
2. Division 26 - ELECTRICAL for electrical service for motor operators, controls, and other powered devices for motorized gymnasium equipment.
3. Division 26 - ELECTRICAL for electronic scoreboards.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For gymnasium equipment. Include plans, elevations, sections, details, attachments to other work, and the following:

1. Method of field assembly for removable equipment, connections, installation details, mountings, floor inserts, attachments to other work, and operational clearances.
2. Transport and storage accessories for removable equipment.

C. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, point reactions, and locations for attachment of gymnasium equipment to structure.

D. Coordination Drawings: Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finished flooring.

E. Samples for Initial Selection: For each type of gymnasium equipment indicated.

F. Samples for Verification: For the following products:

1. Pad Fabric: Not less than 3 inches square, with specified treatments applied. Mark face of material.

G. Product Certificates: For each type of gymnasium equipment, signed by product manufacturer.

H. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.

C. 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.

D. Equipment shall conform to applicable rules and specifications of National Federation of State High School Associations (NFSHSA).

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, 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.

B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.6 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.

B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SAFETY PADS

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. ADP Lemco Inc.
2. Draper Inc.
3. Jaypro Sports, LLC.
4. Porter Athletic Equipment Company.

B. Safety Pad Surface-Burning Characteristics: ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Pad Coverings: Provide safety pad fabric covering fabricated from puncture- and tear-resistant, not less than 14-oz./sq. yd PVC-coated polyester or nylon-reinforced PVC fabric treated with fungicide for mildew resistance; with surface-burning characteristics indicated, and lined with fire-retardant liner.

D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.

1. Size: Each panel section, as indicated.
2. Number of Panel Sections: As indicated modular panel sections.
3. Installation Method: Concealed mounting Z-clips, unless indicated otherwise.
4. Fabric Covering Color(s): As selected by Architect from manufacturer's full range for two color(s).

2.2 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.

1. Verify critical dimensions.
2. Examine supporting structure and subgrades, subfloors and footings below finished floor.

3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly, where required.

B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

D. Permanently Placed Gymnasium Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.

1. Floor Insert Location: Coordinate location with application of game lines and markers, and core drill floor for inserts after game lines have been applied.
2. Floor Insert Installation: Set metal sleeve into cored concrete slab with non-shrink grout and secured to floor slab. Attach sleeve base to underside of the slab with expansion anchors.
3. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and type of floor plate.
4. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

E. Safety Pads: Mount with bottom edge at 4 inches above finished floor.

F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.

3.3 ADJUSTING

A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 124810

ENTRANCE FLOOR MATS 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. Roll-up aluminum-tread rail floor mats with aluminum hinges.
2. Carpet-type matting.

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 work, including forming, placing, and finishing concrete floor slabs, and for concrete materials for grouting and filling around and under recessed mats and frames.

1.3 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 the following:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor moldings.

C. Samples for Verification: For each type of product indicated.

1. Floor Mat: 12-inch- square, assembled sections of floor mat.
2. Frame Members: 12-inch- long Sample of each type and color.

D. Maintenance Data: For floor mat and frames to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats and frames 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.

1.6 COORDINATION

A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

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. Roll-up Aluminum Rail Hinged Mats:

a. AFCO-USA.
b. Balco, Inc.
c. Construction Specialties, Inc.
d. Mats Inc.
e. Nystrom.

2. Carpet-Type Matting:

a. AFCO-USA.
b. Mats Inc.
c. Milliken.
d. Nystrom.
e. Shaw Contract.
f. Tennessee Mat Company, Inc.

2.2 METAL FRAME MATERIALS

A. Extruded Aluminum: ASTM B 221 alloy 6061-T6 or alloy 6063-T5, T6, or T52 as standard with manufacturer.

2.3 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete materials complying with Section 033000 - CAST-IN-PLACE CONCRETE for grout and fill around and under recessed mats and frames that produce concrete equivalent in strength to cast-in-place concrete slabs. For concrete fill, adjust aggregate size to not exceed one-third fill thickness.

2.4 FLOOR MATS

A. General: Provide colors, patterns, and profiles of materials, including metals and metal finishes indicated or specified. If not indicated, provide colors, patterns, and profiles selected by Architect from manufacturer's standards.

B. Roll-up Aluminum Rail Hinged Mats: Clear-anodized finish, extruded-aluminum tread rails sitting on continuous vinyl cushions with 1-1/2-inch-wide by 3/8-inch-thick, tread rail modules. Provide aluminum hinges and 28-oz./sq. yd. weight, level-cut, nylon-pile, fusion-bonded carpet tread inserts].

1. Tapered Rigid Frame: Tapered extruded-aluminum frame members, not less than 1-1/2 inches wide, with mitered corners and finish to match tread-slat extrusions.

C. Loop Filament Matting: 3M's "Nomad" loop filament vinyl material 3/8 inch thick, with solid vinyl sheet backing and built-in chemical agents to reduce fungus and mildew. Provide color specified or scheduled or, if not specified or scheduled, as selected by Architect.

1. Flexible Edging: 2-inch-minimum, vinyl edge strip in matching color, bonded to each end of mat material or backing sheet.

D. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated.

1. 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."
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 and sealants.

2.5 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. Recessed Metal Mat Frames: Extruded aluminum of size and style to fit floor mat type specified, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

D. With manufacturer's standard protective coating, coat surfaces of aluminum frames that will contact cementitious material.

2.6 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.

2.7 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 location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.

1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

B. 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 or may be obtained by written or telephone request.

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: A0.03 - 0.20, AD.00 - D.05, A2.01 - 2.02, A3.00 - 3.14, A4.01 - 4.02, A5.01 - 5.25, A6.01 - 6.04, A7.01 - 7.03, A8.01 - 8.12, A9.01 - 9.11, A10.10 - 10.31

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. Items To Be Furnished Only: Furnish the following items for installation by the designated Sections

1. Section 033000 - CAST-IN-PLACE CONCRETE:

a. Lintels, sleeves, anchors, inserts, plates and similar items for elevators.

2. Section 042000 - UNIT MASONRY:

a. Elevator rail bracket inserts.

C. 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 09 - FINISHES 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. Fujitec America, Inc.
2. KONE Inc.; EcoSpace Elevator
3. Otis Elevator Co.; Gen2 Stream.
4. Schindler Elevator Corp.
5. ThyssenKrupp Elevator; Endura MRL Elevator

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. Operation System: Selective collective automatic operation.

a. Standby power operation.
b. Standby powered lowering.
c. Battery-powered lowering.
d. Independent service.
e. Loaded-car bypass.
f. Automatic dispatching of loaded car.
g. 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 specified in Division 9.

6. Hoistway Entrances: As follows:

a. Width: As indicated on the Drawings
b. Height: As indicated on the Drawings.
c. Type: Asindicated on Drawings.
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.

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. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on

standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.

2. 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. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations. Key is removable only in deactivated position.
3. 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.

H. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

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 210001

FIRE PROTECTION (Filed Sub-Bid Required.)

PART 1 - GENERAL

1.00 GENERAL PROVISIONS

A. Part A and Division 1 of Part B are hereby made a part of this specification Section.

B. Examine all conditions as they exist at the project, prior to submitting a bid for the work of this section

1.01 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.”

1.02 REQUIREMENTS FOR FILING SUB-BIDS

A. 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 submitted electronically at a time and place as stipulated in the “Instructions to Bidders.”
2. Sub-bidders must be DCAMM Certified in the listed trade and shall include a current DCAMM sub-bidder Certificate of Eligibility and Update Statement with the bid.
3. Sub-bids filed with the Awarding Authority shall be accompanied by Bid Bond, Cash, Certified Check, Treasurer’s Check, or Cashier’s Check issued by a responsible bank or trust company payable to the Newton School District in the amount of 5 percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified shall be rejected.

B. Sub Sub-Bid Requirements: None.

1.03 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. Sprinkler heads, piping, fittings and valves.
2. Tests of all piping, systems, devices and alarms.
3. Sleeves, escutcheons, hangers and supports.
4. Flow tests.
5. Pressure gauges.
6. Miscellaneous steel supports.
7. Sprinkler drains.
8. Identification of systems, equipment and valves.
9. Shop drawings and submittals.
10. Permits, fees and inspections.
11. System and equipment start-ups; instructions.
12. Operation and Maintenance Manuals.
13. Coordination drawings and record drawings and similar requirements.
14. Hoisting Equipment: The Fire Protection subcontractor shall furnish, install and maintain in safe and adequate condition all mechanical hoisting equipment, operating personnel and rigging that is necessary for the proper execution of the Work of this Section.

15. Fire stopping and smoke stopping of penetrations made by/ for this sub contractor

B. Items to Be Furnished Only: Furnish the following items for installation by the designated Sections:

None

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

1. Section 26 00 01 - ELECTRICAL for fire alarm devices.

D. Perform work and provide material and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

E Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

F. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

1.04 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.05 DEFINITIONS

A. As used in this Section, "provide" means "furnish and install" and "POS" means "Provided Under Other Sections". "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

1.06 SUBMITTALS

A. Comply with requirements specified in Section 01 33 00 – SUBMITTALS.

B. Material and equipment requiring Shop Drawing Submittals shall include but not be limited to:

1. Fire Protection Products:
   a. Sprinkler heads.
   b. Pipe and fittings.

1.07 CONTRACT DOCUMENTS

A. Listing of Drawings does not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, and other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of this Section must be coordinated.

B. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.

C. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

1.08 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 un clarities 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.

1.09 MODIFICATIONS IN LAYOUT

A. Fire Protection 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 Reflected Drawings for exact locations and where not definitely indicated, request information from Designer.

1.10 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer.

1.11 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by the User Agency. Report conditions that might affect work adversely in writing through Construction Manager to Designer. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

1.12 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, mechanical, electrical, fire and health department

codes.

2. Latest National Fire Protection Association (NFPA).
3. American Insurance Association (A.I.A.) (formerly National Board of Fire Underwriters).
4. Occupational Safety and Health Act (OSHA).
5. Factory Mutual Association (FM).
6. Underwriters' Laboratories (UL).
7. American National Standards Institute (ANSI).

B. Material and equipment shall be listed by Underwriters' Laboratories (UL), and approved by ASME for intended service.

C. When requirements cited in this Specification conflict with each other or with Contract Documents, most stringent shall govern work. Designer may relax this requirement when such relaxation does not violate ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

1.13 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee Work of this Section in writing for one year following the date of beneficial occupancy by the User Agency. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Designer's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

1.14 RECORD DRAWINGS

A. Comply with requirements specified in Section 017700 – PROJECT CLOSEOUT and Section 017839-Project Record Documents.

1.15 BULLETINS, MANUALS, AND OPERATING INSTRUCTIONS, AND PROTECTION

A. Furnish three copies of manuals to Designer for approval and distribution to Project Manager. Deliver manuals no less than 30 days prior to acceptance of equipment to permit User Agency's personnel to become familiar with equipment and operation prior to acceptance. Refer to section 017823-Operation and Maintenance Data.

1.16 COORDINATION DRAWINGS

A. This fire protection contractor shall prepare coordination drawings clearly showing how his work is to be installed in relation to the other trades, including sections and details, as required under Section 007225 Construction Manager Supplemental Conditions and Section 01 33 00 - SUBMITTALS.

1.17 SPRINKLER WORKING PLANS

A. Definition: Working plans are the installation shop drawings required by NFPA Standard 13 and normally prepared by the installing sub-contractor.

B. Submit working plans to the authorities having jurisdiction for approval, including:

1. Building Department.
2. Fire Department.
3. Designer.

C. Prepare sprinkler head layout plans on reflected ceiling plans for submission to the Designer before submission of the working plans.

D. Submit working plans and hydraulic calculations to the Designer in one complete package, after review by the other authorities having jurisdiction. Plans submitted without review stamps or hydraulic calculations will be returned without review.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire protection system products which may be incorporated in the work include, but are not limited to, the following:

1. Sprinkler Heads:
   Automatic Sprinkler Corp. Of America
   Central Sprinkler Corp.
   Reliable Automatic Sprinkler Co., Inc.
   Star Sprinkler Corp.
   Viking Corp.

2.02 PIPING, FITTINGS AND JOINTS

A. Fire Line Piping:

1. Black steel Schedule 40, ASTM A53 with flanged, threaded, or grooved joints.
2. Black steel Schedule 10, ASTM A135 lightwall with roll-grooved fittings.

B. Sprinkler Piping:

1. 1-1/2” inches and smaller: ASTM 135 Schedule 40 black steel (galvanized for dry sprinkler system) with threaded joints.
2. 2 inches and larger: ASTM 135 Schedule 10 lightwall with roll grooved joints or Schedule 40 black steel (galvanized for dry sprinkler system) with grooved or threaded joints. Sizes 1-inch through 3-inches may be Allied galvanized XL threadable lightwall steel pipe with threaded joints and fittings.

C. Fittings:

1. Ductile Iron: ASTM A-536.
2. Malleable Iron: ANSI B16.3.
3. Steel: ANSI B16.11.
4. Cast Iron: ANSI B16.4. (Not for use in dry system.)

D. Grooved Fittings and Couplings:

1. Grinnell Fig. 7000, Gustin-Bacon No. 105 or Victaulic Style 75.
2. Compatibility: Couplings and fittings shall be of a single manufacturer or shall be certified as compatible by both manufacturers.

2.03 AUTOMATIC SPRINKLERS

A. Sprinkler Heads: Glass Bulb type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal 1/2 inch discharge orifice, for “Ordinary” temperature range.

B. Sprinkler Heads Finishes: Provide heads with the following finishes:

1. Upright, Pendent, and Sidewall Styles: chrome plated in finish spaces, exposed to view; rough bronze finish for heads in unfinished spaces and not exposed to view. Heads shall be wax-coated where installed exposed to acids, chemicals, or other corrosive fumes.
2. Concealed Style: rough brass, with painted white cover plate.
3. Refer to drawing for locations of sprinkler head styles
4. Follow NFPA-13, Table 8.3.2.5 for sprinkler temperature rating requirement.
5. Provide sprinkler cage at all sprinkler heads mounted less than 9' high.

C. Sprinkler Head Cabinet and Wrench: finished steel cabinet, suitable for wall mounting, with hinged cover and 6 spare sprinkler heads on the project.

2.04 PIPE AND HANGER SUPPORTS

A. Provide pipe supports, sway braces, hangers, and clamps conforming to NFPA 13 and listed by UL and approved by FM. Provide protection of piping against earthquake damage in accordance with NFPA 13.

2.14 FIRE STOPPING

A. Seal openings of fire rated construction with a material or product that has been tested at an independent testing laboratory, such as UL, FM, etc. Fire stopping shall conform to ASTM E-814 and UL 1479, with fire ratings equal to or exceeding the fire rating of the construction involved. Fire stopping shall be UL classified, and shall be similar to the 3M brand Fire Barrier Penetration Sealing Systems, or approved equivalent. Fire stopping of this type shall also be utilized for openings through smoke rated construction.

PART 3 - EXECUTION

3.01 PIPE APPLICATIONS

A. Install piping in accordance with NFPA 13 for sprinkler systems.

B. Install Schedule 40 steel pipe with threaded joints and fittings for 2-inch and smaller, and with welded joints for 2-1/2 inch and larger.

C. Install Schedule 40 steel pipe with roll-grooved ends and grooved mechanical couplings for piping 2-inch and smaller.

D. Install Schedule 10 steel pipe with roll-grooved ends and grooved mechanical couplings for piping 2-1/2 inch and larger.

3.02 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated.

1. Deviations from approved "Working Plans" for sprinkler piping, require written approval of the authority having jurisdiction. Written approval shall be on file with the Designer prior to deviating for the approved "Working Plans."

B. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.

C. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions in pipes 2-inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

E. Hangers and Supports: Comply with the requirements of NFPA 13 and NFPA 14. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13.

3.04 PIPE JOINT CONSTRUCTION

A. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.

2. Align threads at point of assembly.

3. Apply appropriate tape or thread compound to the external pipe threads.

4. Assemble joint to appropriate thread depth. When using a wrench on valves, place the wrench on the valve end into which the pipe is being threaded.

5. Damaged Threads: Do no use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

6. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

7. Mechanical Grooved Joints: Cut or roll grooves on pipe ends dimensionally compatible with the couplings.

8. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

a. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

9. Soldered Joints: Comply with the procedures contained in the Copper Development Association "Handbook for Fire Sprinkler Systems."

10. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.05 SPRINKLER HEAD INSTALLATIONS

A. Use proper tools to prevent damage during installations.

3.06 TESTING

A. Testing and flushing of the fire protection systems shall be done at the expense of this Subcontractor and with equipment furnished by him. Testing shall be done in the presence of duly authorized inspectors and representatives of the Designer and 's Project Manager within forty-

eight (48) hour notice given those authorities. Prior to testing, the system shall be thoroughly flushed with clean water.

SECTION 220001 – PLUMBING (Trade Sub-Bid Required)

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SECTION 22 00 01 - PLUMBING (Filed Sub-Bid Required)

PART 1 – GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

A. Work of this Section requires Trade Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44J, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

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 REQUIREMENTS FOR FILING SUB-BIDS

A. 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 submitted electronically at a time and place as stipulated in the “Instructions to Bidders.”
2. Sub-bidders must be DCAMM Certified in the listed trade and shall include a current DCAMM sub-bidder Certificate of Eligibility and Update Statement with the bid.
3. Sub-bids filed with the Awarding Authority shall be accompanied by Bid Bond, Cash, Certified Check, Treasurer’s Check, or Cashier’s Check issued by a responsible bank or trust company payable to the Newton School District in the amount of 5 percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified shall be rejected.

B. Sub Sub-Bid Requirements: Referenced in Paragraph 2.8 Pipe Covering (Insulation) of this section.

1.4 RELATED SECTIONS

A. Division 01 Section 01 50 00 “Temporary Facilities and Controls”

B. Section 07 54 00 – Thermoplastic Membrane Roofing for Flashing of roof mounted equipment and roofing penetrations for plumbing piping and equipment.

C. Section 01 73 29 0 Cutting and Patching
1) All roofing cutting and patching is the responsibility of the roofing file sub trade. All cutting and patching of the existing gyp. roof deck is the responsibility of the structural steel sub. All opening for filed sub trade that are 12” square are the responsibility of that filed sub trade.

D. Section 07 84 10 – Penetration Fire Stopping.
1) Filed sub trades is responsible for firestopping their own penetration for fire rated wall.
2) Filed filed sub trades is responsible for sealing their own penetration at all walls

E. Section 09 90 00 – Painting.
F. Section 10 28 00 – Toilet and Bath Accessories
G. Section 26 00 00 – Electrical for work associated with plumbing equipment

1.5 -----NOT USED----

1.6 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. Disconnect and Removal of plumbing fixture and associated piping as noted on drawings.
2. Domestic cold water system throughout the entire building connecting to each and every fixture and piece of equipment requiring domestic cold water.
3. Domestic Hot Water and Hot water return system throughout the entire building connecting to each and every fixture and piece of equipment requiring domestic hot water.
4. Plumbing Fixtures, Domestic Water Heater and Accessories.
5. Sanitary waste and vent system throughout the entire building connecting to each and every fixture and piece of equipment requiring sanitary drainage. This system shall extend and connect to the sanitary main ten feet outside of the building.
6. Floor, Roof Drain and secondary roof drain and piping.
7. Water Meters, Backflow preventer, Valves.
8. Floor, area and roof drains.
9. Insulation.
10. Hangers, supports and attachments.
11. Video inspection and cleaning of existing underground piping.
12. Disinfection of water piping
13. Video Inspection of existing underground sanitary and storm piping
14. Pressure Jet Clean all underground existing piping and video inspection after cleaning.
15. Circulating pumps and controls.
16. All cutting, core drilling and channeling for plumbing equipment for holes 12” in diameter or less.
17. Fire Stopping for plumbing pipe penetration in fire rated construction.
18. Coordination drawings and record drawings and similar requirements.
19. Hoisting Equipment: The Plumbing subcontractor shall furnish, install and maintain in safe and adequate condition all mechanical hoisting equipment, operating personnel and rigging that is necessary for the proper execution of the Work of this Section.
20. Staging, Planking and Scaffolding: The Plumbing subcontractor shall furnish, install and maintain in safe and adequate condition, all staging, planking and scaffolding that is necessary for the proper execution of the Work in this Section.
21. Smoke proofing of all plumbing penetrations in smoke barrier penetration.
22. Caulking around plumbing fixtures in toilets and counter top faucets.

B. The plumbing drawings are P0.01, P0.02, PD1.01, PD1.02,P2.00, P2.01, P2.02, P2.03, & P3.01. The Plumbing Trade Contractor shall also review all related Drawings and all related Sections of the Specifications for coordination requirements therein affecting the Work of this Section, not just those pertaining to this Sub-trade

C. Alternates: Refer to Division 01 Section “Alternates.”

D. Items To Be Furnished Only: Furnish the following items for installation by the designated Sections:

1. Section 07 00 02 – ROOFING & FLASHING:
   a. Roof drain sump receivers. Furnish and installed by plumbing with flashing by Roofing trade.
2. Section 08 31 13 ACCESS DOORS AND FRAMES for access doors to be furnished for installation by General Trades Subcontractor.
3. Section 26 00 02 - ELECTRICAL:
   a. Magnetic starters.
   b. 120V / 24V Control Transformer for electronic faucets
4. Section 03 30 00 Cast in Place
   a. Sleeves
5. Section 04 20 00 Masonary

a. Sleeves

6. Section 09 06 00 Gypsum Board Assemblies
   a. Sleeves

E. Perform work and provide material and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

F. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

G. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

1.7 SUBMITTALS

A. Comply with requirements specified in Section 013300 – SUBMITTALS.

B. Material and equipment requiring Shop Drawing Submittals shall include but not be limited to:
1. Plumbing fixtures and trim.
2. Water heater and circulating pumps.
3. Roof and floor drains.
4. Piping.
5. Fittings, unions, flanges, and couplings.
6. Insulation.
7. Valves, regulators and meters.
8. Water hammer arrestors.
9. No-hub couplings.
10. Backflow preventers.
11. Hangers, plates, and inserts.
12. Vibration isolation and flexible connections.
13. Pressure reducing station

1.8 DEFINITIONS

A. As used in this Section, "provide" means "furnish and install" and "POS" means "Provided Under Other Sections". "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

1.9 MODIFICATIONS IN LAYOUT

A. Plumbing 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 shall 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.

1.10 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that shall affect work of this Section. No extra payment shall be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer.

1.11 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by the Owner. Report conditions that might affect work adversely in writing through General Contractor to Designer. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

1.12 PHASING, DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, coordinate required demolition or relocation of existing fixtures and plumbing systems in the existing building areas where new work is to be installed or new connections are scheduled to be made and as required by job conditions.

B. Plumbing utilities shutdown required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the User Agency's designated representative, for specified, mutually agreeable periods of time, after each of which the interruption shall cease and the service shall be restored. This procedure shall be repeated to suit the User Agency's working schedule, as many times as required until all work is completed. Any shutdown shall be approved by Project Manager, prior to commencing the work.

C. All demolition of Plumbing systems and equipment designed to be demolished shall be provided by the Plumbing Subcontractor. Place all demolished plumbing materials on floor (except hazardous materials) for disposal by the General Contractor. All hazardous plumbing materials shall be legally disposed by the plumbing subcontractor.

1.13 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, fuel gas mechanical, electrical, fire and health department codes.
2. Obtain Permit and obtain necessary approvals from authorities that have jurisdiction.
3. American Gas Association (AGA).
4. National Fire Protection Association (NFPA).
5. American Insurance Association (A.I.A.) (formerly National Board of Fire Underwriters).
6. Occupational Safety and Health Act (OSHA).
7. Factory Mutual Association (FM).
8. Underwriters' Laboratories (UL).
9. American National Standards Institute (ANSI).

B. Material and equipment shall be listed by Underwriters' Laboratories (UL), and approved by ASME and AGA for intended service.

C. Plumbing Fixtures and Potable water shall meet both the NSF 61, lead free and NSF 372 test Standards via third-party testing and certification.

D. When requirements cited in this Specification conflict with each other or with Contract Documents, most stringent shall govern work. Designer may relax this requirement when such relaxation does not violate ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

E. Most recent editions of applicable specifications and publications of the following organizations form part of Contract Documents:

1. American National Standards Institute (ANSI).
2. American Society of Mechanical Engineers (ASME).
3. National Electric Manufacturers Association (NEMA).
4. American Society for Testing and Materials (ASTM).
5. American Water Works Association (AWWA).
6. Institute of Electrical and Electronics Engineers (IEEE).
7. National Fire Protection Association (NFPA).

1.14 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee Work of this Section in writing for one year following the date of substantial completion. he guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Designer's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 01 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in User Agency's name.

C. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Designer.

D. Provide 24 hour service beginning on the date of substantial completion, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to school.

E. Submit copies of equipment and material warranties to Designer before final payment.

F. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to User Agency.

G. Part 2 Paragraphs of this Specification may specify warranty requirements that exceed those of this Paragraph.

H. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by User Agency, and shall not institute guarantee period.

I. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately, advise Designer in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Designer will suggest course of action.

1.15 RECORD DRAWINGS

A. Comply with requirements specified in Section 01 78 39 – PROJECT RECORD DOCUMENTS and Section 017700-Project Closeout.

B. Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

1.16 DEMONSTRATION AND TRAINING

A. Refer to Specification Section 01 79 00 Demonstration and Training.

1.17 BULLETINS, MANUALS, AND OPERATING INSTRUCTIONS, AND PROTECTION

A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field-assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:

1. Directions for and sequence of operation of each item of Plumbing systems. Sequence shall list valves, switches, and other devices used to start, stop and control system. Include approved valve directory showing each valve number, location of each valve, and equipment or fixture controlled by valve.

2. Detailed maintenance and trouble shooting manuals containing data furnished by manufacturer for complete maintenance. Include copy of balancing report.

3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

B. Furnish three copies of manuals to Designer for approval and distribution to owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit User Agency's personnel to become familiar with equipment and operation prior to acceptance.

C. Provide framed and glazed charts as follows: mount as directed by Designer.
1. Flow diagrams from first part of manual as described above.

2. Valve directory.
3. Lubrication chart from third part of manual.

D. Operating instructions: Upon completion of installation or when Designer accepts portions of building and equipment for operational use, instruct User Agency's operating personnel in any or all parts of various systems. Instructions shall be performed by factory-trained personnel. User Agency shall determine which systems require additional instructions. Duration of instructions shall take equipment through complete cycle of operation (at least five working days). Make adjustments under operating conditions. Plumbing subcontractor shall videotape all instructions given to the owner, and shall provide up the three hours of videotape instructions. Three copies of the videotaped instructions shall be submitted by the owner.

E. Each contractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material.

F. Each separate contractor shall protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.

1.18 COORDINATION DRAWINGS

A. This plumbing sub-contractor shall prepare coordination drawings clearly showing how his work is to be installed in relation to the other trades such as HVAC, Electrical, Fire Protection and including sections and details, as required under Section 01 31 00 – PROJECT MANAGEMENT AND COORDINATION.

1.19 LOCATION OF FIXTURES AND EQUIPMENT

A. The Architect will establish the exact location of all fixtures, equipment, and devices to be located in finished spaces of the building. Such precise locations are, for the most part, indicated on the Architectural Plans of the various spaces, and it shall be the responsibility of this SECTION 22 00 01 Subcontractor to obtain instructions from the Architect for the location of any items whose location is not specifically given on the Architectural Drawings. Any work installed contrary to the Architectural Drawings, or without the prior approval of the Architect, shall be relocated and any necessary changing or patching of the surrounding work shall be done at the expense of this SECTION 220001 Subcontractor.

1.20 CEILING MARKER SYSTEM

A. At all valves located above ceilings of any type, ceilings shall be marked with tacks firmly attached to the ceiling surface. Tacks shall be part of a complete system, Brady Co. *Valve Finder Ceiling Tacks* or approved equal product from Westline Products or Seton Name Plate Co.

PART 2 - PRODUCTS

2.1 PIPE, FITTINGS AND JOINTS

A. General

1. Pipe and fittings shall conform to the latest ANSI, ASTM, NFPA and AWWA Standards including latest amendments.

2. Each length of pipe, each pipe fitting, trap, material and/or device used in the respective system shall have cast, stamped or indelibly marked on it, the maker's name or mark, weight and quality of the product when such marking is required by the approved standard that applies.

3. Piping and fittings shall be factory coated.

B. Sanitary Drainage Piping Above Floor (Soil, Waste and Vent)

1. Piping 2" and larger shall be no-hub service weight cast iron soil pipe except at urinals and cleanouts and joints just prior to exiting the building which shall be service weight hub and spigot with lead and oakum joints. The pipe shall be legibly marked on the barrel with the manufacturer's name and/or trademark.

2. All cast iron soil pipe and fittings shall conform to the requirements of CISPI Standard 301, ASTM A 888 or ASTM A 74 for all pipe and fittings.Pipe and fittings shall be marked with the collective trademark of the CastIron Soil Pipe Institute or receive prior approval of the engineer. Latest issue of each standard shall apply.

3. Sanitary piping 2” and smaller shall be type “L” copper.

4. Couplings for joining no-hub cast iron soil pipe: ASTM C1540, Couplings shall have a shield constructed of corrugated 304 stainless steel and provide a shield thickness of 0.16 inches or greater. Shield shall be a minimum width of 3 inches for pipe sizes 1-1/2 inch through 4 inch, and a minimum width of 4 inches for pipe sizes 5 inch through 10 inches. Couplings with at least 4 sealing bands shall require 80 inch pounds of torque per band. Tightening screws shall be 3/8 inch hexagon head. Couplings with only 2 sealing bands on sizes 1-1/2 inch through 4 inches shall require 125 inch pound of torque per band. Gaskets shall be neoprene rubber conforming to ASTM C-564.

5. Joints in copper tubing except as otherwise specified herein shall be made according to manufacturer's specifications using sweat fitting and lead free solder and non-corrosive flux.

6. Connections between earthenware of any fixture and flanges in soil and waste piping shall be made absolutely gas and watertight with closet setting compounds and gaskets which must be absolutely gas and fireproof, watertight, stain proof, containing neither oil nor asphaltum and which shall not rot, harden or dry under any extreme climatic change, and must adhere on wet surfaces.

C. Sanitary Drainage Piping Below Floor (Soil, Waste and Vent)

1. Piping below floor shall be service weight cast iron hub and spigot.

2. Joints in cast iron soil piping below ground shall be code approved compression type, made with rubber gaskets conforming to ASTM Specification C564. Joints in cast iron soil pipe and fittings using a double seal, compression type molded neoprene gasket shall be provided with a modified hub as required to provide a positive seal. No-hub pipe shall not be allowed below ground. (Adhesive type lubricant shall be used with the resilient gaskets on pipes 5" and larger).

D. Storm Drainage Piping Above Floor

1. Piping shall be no-hub service weight cast iron soil pipe except at cleanouts and joints just prior to exiting the building which shall be service weight hub and spigot with lead and oakum joints.

2. Couplings for joining no-hub cast iron soil pipe: ASTM C1540, Couplings shall have a shield constructed of corrugated 304 stainless steel and provide a shield thickness of 0.16 inches or greater. Shield shall be a minimum width of 3 inches for pipe sizes 1-1/2 inch through 4 inch, and a minimum width of 4 inches for pipe sizes 5 inch through 10 inches. Couplings with at least 4 sealing bands shall require 80 inch pounds of torque per band. Tightening screws shall be 3/8 inch hexagon head. Couplings with only 2 sealing bands on sizes 1-1/2 inch through 4 inches shall require 125 inch pound of torque per band. Gaskets shall be neoprene rubber conforming to ASTM C-564.

E. Storm Drainage Piping Below Floor

1. Piping below floor shall be service weight cast iron hub and spigot.

2. Joints in cast iron soil piping below ground shall be code approved compression type, made with rubber gaskets conforming to ASTM Specification C564. Joints in cast iron soil pipe and fittings using a double seal, compression type molded neoprene gasket shall be provided with a modified hub as required to provide a positive seal. No-hub pipe shall not be allowed below ground.

F. Water Piping (For Domestic Cold and Hot water)

1. Above Ground

a. 2-1/2 inches and smaller shall be hard drawn Type L copper with wrought or cast copper fittings.
b. 3 inches and larger may be hard drawn Type L copper with roll grooved mechanical couplings.
c. Joints in copper tubing except as otherwise specified herein shall be made according to manufacturer's specifications using sweat fitting and lead free solder and non-corrosive flux.
d. Provide galvanized malleable iron unions, with bronze facings conforming to ANSI B16.39 for sizes 2 inch and smaller.
e. Provide copper flanges conforming to ANSI B16.5, standard or welding neck pattern.

G. Unions and Flanges

1. Unless otherwise specified herein, unions for copper and brass piping two inches and smaller in diameter shall be 125 SWP, bronze body brass ground joint type. Those larger than two inches in diameter shall be 150 SWP flat faced cast brass flanges conforming to ANSI Standard B16.24.

2. Where brass flanges and ferrous flanges are to be joined, ferrous flanges shall be full faced.

3. Mating of ferrous and non-ferrous flanges shall be separated with rubber gaskets (1/16 inch minimum thickness) and teflon liners installed in the bolt holes. Bolt holes shall be drilled to receive the teflon lines. Physical contact between the ferrous and non-ferrous flanges including the bolts, nuts and washers shall not be permitted.

4. Unions for ferrous piping shall be of the same material as the piping to which they connect.

2.2 VALVES AND SUNDRIES

A. General

1. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed. Nibco, Watts, Apollo or approved equal.
2. Valve Design: Rising stem or rising outside screw and yoke stems.
3. Nonrising stem valves may be used where headroom prevents full extension of rising stems.
4. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
5. Sizes: Same size as upstream pipe, unless otherwise indicated.
6. Operators: Provide the following special operator features:

    a. Handwheels, fastened to valve stem, for valves other than quarter turn.

    b. Lever handles, on quarter turn valves 6 inch and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.
7. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
8. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
9. End Connections: As indicated in the valve specifications.
    a. Threads: Comply with ANSI B1.20.1.
    b. Flanges: Comply with ANSI B15.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
    c. Solder-Joint: Comply with ANSI B16.18.
        1) Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. F for gate, globe, and check valves; below 421 deg F for ball valves.

B. Valves in the interior domestic water piping systems (cold water, hot water) and gas system:

1. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, Nibco, Watts, Apollo, or approved equal.

2. Ball Valves

    a. Ball Valves, 1 Inch and Smaller: Rated for 400 psi WOG pressure; two piece construction; with 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 solder ends for domestic hot and cold water service.

b. Ball Valves, 1-1/4 Inch to 2 Inch: Rated for 400 psi WOG pressure; 3 piece construction; with 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 solder ends for domestic hot and cold water service.

C. Sundries

1. Acceptable Manufacturers: Chicago Faucet, Watts, T & S Brass and Bronze Works, Inc., Speakman Co., Josam Manufacturing, Jay R. Smith, Precision Plumbing Products or approved equal.
2. Vacuum breakers shall be full size of line feed. All hose bibbs shall be supplied with vacuum breakers attached to hose thread portion of hose bibb unless they are integral to fixture.
3. Hose bibbs shall be equal to the following:

   a. HB1: (Toilet Rooms) Wall mounted sill fitting, atmospheric vacuum breaker, 3” cross handle, slow compression cartridge. Equal to Chicago No. 952 -633OLCP (1/2"), Josam, Watts.

   b. Frostproof Hose Bibb (FPHB): The wall hydrant shall be Polished bronze, Non-freeze, anti siphon, automatic draining hydrant with stainless steel face, hose connection, integral vacuum breaker and dual check valve, "T" handle key. Coordinate wall thickness. Furnish and deliver two operating keys, hydrant part repair kit to the custodian. The wall hydrant shall be equal to Zurn Z1310, Jay R Smith, Josam, Watts or equal.

4. Shock absorbers (Hammer arrester) shall be of the mechanical, pre-pressurized type installed where indicated and in accordance with "Standard P.D.I.-WH201.” All shock absorbers must be located behind access panels or in readily accessible areas.

5. Combined Pressure Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210 deg F, and pressure relief at 150 psi.

6. Pressure Regulating Valves: Single seated, direct operated type; having bronze body with integral strainer, and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and inlet and outlet pressures indicated.

7. Relief Valves: Provide proper size for relief valve, in accordance with ASME Boiler and Pressure Vessel Codes, for indicated capacity of the appliance for which installed.

8. Manual Balancing Valve: Lead free flow calibrated brass balancing valve with built in flow meter and sight gauge. Furnish with check valve to protect circuit thermos siphoning.
9. Thermal Expansion Tank: The expansion tank diaphragm or bladder type shall be welded steel, constructed, tested and stamped in accordance with section VIII, Division 1 of the ASME code for a working pressure of 150 psig, factory air pre-charged and field adjustable. All welds conforming to ASME section IX. All internal parts must comply with FDA regulations and approvals.

2.3 BACKFLOW PREVENTION DEVICES

A. General

1. Reduced pressure backflow preventers shall lead free construction and shall have bronze inlet strainer, bronze body construction, removable bronze seats, stainless steel internal parts, bronze-bodied ball valve test cocks, non-rising stem gate valves with union or flanged connections between the valves and the device itself, inlet and outlet pressure gauges and comply with requirements of ASSE Standard 1013. Size as indicated on the Drawings. Approved equals may be accepted with proof of state approval. The backflow preventer shall meet shall meet both the NSF 61 and NSF 372 test standards.
2. Furnish one (1) spare parts kits for each size of device to be installed.
3. Furnish one (1) test kit for use with the reduced pressure devices. The test kit shall be contained in its own carrying case.

B. Acceptable Manufacturers

1. All units shall meet the approval of all Local and State Authorities and be approved by the Department of Environmental Protection.
2. Provide product of Watts, Ames Co., or Febco Regulator.

C. Reduced Pressure Zone Backflow Preventer for the Main Water Service (RPBP)

1. Reduced pressure backflow preventers shall be lead free construction and shall be stainless steel construction to provide long term corrosion resistance. The assembly shall consists of pressure differential relief valve located in a zone between two positive seating check valves. The main valve body shall be manufactured from 300 series stainless steel for corrosion resistance. The check valve shall be of thermoplastic construction with stainless steel hinge pins, cam arm and cam bearing. The check valve shall be modular and shall seal to the main valve body by use of an O-ring. The differential relief valve shall be of stainless steel construction and shall utilize a rolling diaphragm and no sliding seats. The assembly shall include two resilient seated shutoff valve and four ball type test cock. Gauges shall comply with requirements of ASSE Standard 1013. Size as indicated on the Drawings. Reduced pressure zone valve shall be equal to watts 994 and shall match the pipe size. Other approved equals are Watts, Ames Co. or equal.

2.4 FLOOR AND ROOF DRAINS

A. General

1. Floor, roof and area drains shall be Jay R. Smith, Josam, MIFAB, or approved equal. Manufacturer's catalog numbers specified herein for drains are intended only as a guide for the type and quality to be furnished under this Section of the Specifications. All floor drain shall be provided with Trap connection.

   a. Floor Drain (FD1- Finished Areas) shall be equal to Jay R. Smith Figure #2005-A-P.

   b. RD-1: Roof drain shall be equal to Jay R. Smith Figure #1010-ERCY with secured cast iron dome extension, sump receiver, underdeck clamp, no-hub adaptor
   c. OD1: Secondary drain shall be equal to Jay R Smith 1074 Siphonic overflow drain with dura-coated ductile iron drain body with poly dome, external combination membrane flashing clamp/ overflow gravel guard. Complete with vandal -proof secured, dura-coated cast iron air restricting baffle and grate, top set deck plate. Provide downspout (DSN) with hinged cover equal to Jay R Smith 1775.

2.5 VENTS THROUGH ROOF

A. All pipes extending through the roof for the sanitary system shall be the same material as the

piping system. Vents shall be of size indicated on the Drawings and extend at least 24 inches above the roof, ending in the top of pipe, which shall be flashed by the Roofing Contractor, for the respective roofing systems.

B. All vent piping within 25 feet from any HVAC intake or as indicated on the drawing must be extended higher and terminate two feet above the maximum height of the air intake.

C. All vent piping shown within the screen wall must extend 12” higher than the top of screen wall.

D. Vent Terminal Extensions shall be hubless cast iron piping.

2.6 HANGERS AND ACCESSORIES

A. General

1. Provide pipe stands, supports, hangers and other supporting appliances as necessary to support work required by Contract Documents. All components of the hanger support system shall comply with the standards set forth in MSS-SP58 and MSS-SP69 (Manufacturers Standardization Society) latest publication.

2. Manufacturers: Subject to compliance with requirements, provide hangers and supports of Carpenter and Patterson, Inc, ITT Grinnel Corp., Elecen Metal Products or approved equal.

B. Secure vertical piping to building construction to prevent sagging or swinging.

C. Space hangers for horizontal piping as follows:

Pipe Size	Rod Diameter	Maximum Spacing
½” and ¾”	3/8”	6 ft-0”
1" and 1-1/4"	3/8"	8 ft.-0"
1-1/2 and 2"	3/8"	10 ft.-0"
2-1/2 and 3"	2"	10 ft.-0"
4 and 5"	5/8"	12 ft.-0"

D. Friction clamps shall be equal to Figures 126 and copper plated when in direct contact with copper or brass piping.

E. Hangers for uncovered (uninsulated) copper or brass piping 2" and smaller shall be Carpenter & Patterson Figure 1ACT steel, copper plated band type.

F. Hangers for uncovered (uninsulated) steel or cast iron piping 2" and smaller shall be Carpenter & Patterson Figure 1A steel band type.

G. Hangers for uncovered (uninsulated) steel or cast iron piping 2-1/2” and larger shall be Carpenter & Patterson Figure 100 steel clevis type.

H. Hangers for all insulated piping shall be Carpenter & Patterson Figure 100 steel clevis type with insulation shield specified below.

I. Hangers for uncovered (uninsulated) copper or brass piping 2-1/2” and larger shall be factory applied copper plated steel clevis hangers, Carpenter & Patterson Fig. 100 CT. Rods and nuts used with these hangers shall also be factory applied copper plated.

J. Where three or more pipes are running parallel to each other, factory fabricated gang type hangers with pipe saddle clips, or rollers may be used in lieu of the hereinbefore specified Clevis hangers. These hangers shall be sized to provide for insulation protectors as hereinafter specified. Pipe saddle clips shall be not less than 16 gauge metal and shall be copper when installed with

uninsulated copper piping. Where pipe rollers are provided for uninsulated copper or brass piping, insulation protectors shall be provided at each set of rollers and filled with a section of heavy density fiberglass pipe covering specified hereinafter. (Refer to insulation of this specification.) Fig. 342 sized to suit loading with hanger rods and nuts.

K. Extension type split ring hangers with wall plates shall be equal to Carpenter & Patterson Figures 81, 81-CT, 90-CT and 85, 85-CT plates for iron, steel and copper.

L. Hanger rods for other installations shall be sized in accordance with the recommended load capacities of ASTM Specifications Designation A-107, latest amendment.

M. Insulation protectors (shields) for horizontal piping shall be constructed of galvanized steel formed to a 180 degree arc and 12 inches long, equal to Carpenter & Patterson Figure 265P, 18 gauge type H for hangers 5 inches in size and smaller, 16 gauge for hangers larger than 5 inches in size.

N. Exposed rods, clamps and hangers shall be electrogalvanized coated.

O. Installation of hangers which permit wide lateral motions of any pipe shall not be acceptable.

P. "C" clamps installed with pipe hangers or equipment hangers shall not be permitted unless provided with retaining straps.

Q. All no-hub cast iron pipe 6 inches or larger in diameter shall be braced to prevent horizontal movement as required by code and recommended by the Cast Iron Soil Pipe Institute by using braces, blocking or rodding as illustrated in the CISPI Handbook, Vol. II, Specification Section 310-78.

2.7 INSERTS AND ESCUTCHEONS

A. Inserts shall be individual or strip type of pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4 inch diameter, permitting lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods up to 2 inch diameter to be passed through the insert body. Strip inserts shall have attached rods with hooked ends to allow fastening to reinforcing rods.

B. Unless otherwise specified herein, escutcheons shall be cast brass chrome plated type and provided with a set screw to properly hold escutcheon in place.

2.8 PIPE COVERING (INSULATION)

A. General

1. The pipe covering specified herein for piping system shall be provided to strict accordance with the manufacturer's printed instructions, the best practice of the trade and to the full intent of this Specification.

2. Flame/Smoke Ratings: Provide complete fibrous glass pipe insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

3. Manufacturer: Subject to compliance with requirements, provide products of Johns Manville “Micro-Lok HP”, Knauf Fiber-Glass, Owens Corning or approved equal.

4. Apply insulation after systems have been tested, proved tight and approved by Designer. Remove dirt, scale, oil, rust and foreign matter prior to installation of insulation.

5. No leaks in vapor barrier or voids in insulation shall be accepted.

6. Insulation and vapor barrier on piping which passes through walls or partitions shall pass continuously through sleeve, except that piping between floors and through fire walls or smoke partitions shall have space allowed for application of approved packing between sleeves and ping, to provide fire stop as required by NFPA. Seal ends to provide continuous vapor barrier where insulation is interrupted.

B. Interior Cold, and Hot Water Recirculation pipe insulation:

1. 1” insulation for all pipe sizes.

   a. ASTM E-547, Class I

2. Hot Water Supply

   a. 1” thick insulation for pipe sizes less than pipe size 1.5” and 1.5” thick insulation for pipe sizes equal and greater than pipe size 1.5”.
   b. ASTM E-547, Class I

3. Fire retardant foil face jackets for ping insulation: ASTM C-921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at installation option.

4. Horizontal Rain water conductors, Overflow drain pipe and waste piping, including underside of drain bodies and vertical drops from drains to offset and elbow at the end of the horizontal run, 1" thick with vapor barrier. Concealed conductor piping, including drains (roof boxes) shall be insulated with two layers of vapor barrier blanket, 1" thick, minimum one pound density.

5. Encase pipe fittings insulation with one piece premolded PVC fitting covers, fastened as per manufacturer’s recommendations.

6. Encase exterior piping insulation with 0.016” thick aluminum jacket with weatherproof construction.

7. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

C. Exposed Piping (Sanitary and Storm) in occupied space with open ceiling

1. Encase exposed piping in ½ insulation and PVC jacket cover

2.9 CLEANOUTS

A. Cleanouts shall be Jay R. Smith, Josam, MIFAB or approved equal.
B. Bodies of cleanout in hub and spigot or no-hub piping shall be standard pipe size conforming in thickness to that required for pipe and fittings, and shall extend not less than 3/4 inch above the hub of the pipe. The cleanout plug shall be of cast brass and shall be provided with a raised nut 3/4 inch high. Cleanouts in threaded waste piping shall be cast iron drainage "T" pattern 90 degree branch fittings with extra heavy brass screw plugs of the same size as the pipe.

C. Floor cleanouts shall be as follows:

1. FCO-1: General purpose flush finished floor cleanout with adjustable top shall be equal to MiFAB C1100-R-BA.

2. CO: Wall cleanout with cast bronze cleanout plug, round smoth stainless steel cover. The cleanout shall be equal to MiFAB C1430-RD-BA.

2.10 PLUMBING FIXTURES

A. In general, the work of this Article shall include, but not be limited to:

1. Plumbing fixtures and trim.
2. Faucets and flushometers.
3. Stops and supplies.
4. Traps and tailpieces.
5. Drain outlets.
6. Mixing valves.
7. Shower assemblies.
8. Flow controls.
9. Carriers and supports.
10. Lavatory insulators.

B. Fixtures and Trim

1. Acceptable Manufacturers: Submit manufacturers not listed below for review and approval as specified for substitutions in this Section.

   a. Vitreous China: Eljer, American Standard, Crane, Kohler or equal.
   b. Faucets: Chicago Faucet Co., Kohler or T & S Brass or equal.
   c. Self Closing Faucets: Chicago Faucet Co., Sloan, Kohler, Symmons or equal.
   d. Stainless Steel Sinks: Elkay, Just Manufacturing, Metcraft Inc or equal.
   e. Mop Service Basins: Crane, Fiat , Stern Williams or equal.
   f. Carriers and Supports: Jay R. Smith, Wade, or equal.
   g. Pressure Regulating Mixing Valves: Lawler Manufacturing, Leonard Valve Co Symmons or equal.
   h. Emergency Eye Wash: Guardian, Haws, Speakman or equal
   i. Water Fountain: Haws, Halsey Taylor, Filtrine or equal.
   j. Flush Valves: Sloan, American Standards, Hydrotek or equal.
   k. Stops and Supplies: Chicago Faucet Co., Kohler or McGuire.
   l. P-Traps: McGuire, Sanitary-Dash, or Jameco.
   m. Handicap Lavatory Insulation: McGuire, TCI Products or Truebro.

2. Fixture Trim and Accessories: Provide fixtures complete with floor mounted fixture carrier supports; faucets, flushometers; drain outlets, tailpieces, P-traps and stops and supplies.

   a. Color and Finish: All trim exposed to view shall be polished chrome plated, and all fixtures and toilet seats shall be white unless specified otherwise.

   b. Drain Outlets: Provide drain outlet of the same manufacturer as the fixture or faucet trim with chrome plated 17 gauge minimum weight tailpiece.

      1) Provide 1-1/4 inch tailpiece on lavatories.
      2) Provide 1-1/2 inch tailpiece on sinks.
      3) Provide offset drain outlets on handicapped use lavatories and sinks.

3. P-Traps: Cast brass adjustable P-trap with cleanout plug, ground joint and 17 gage minimum weight extension with escutcheon.

   a. Provide McGuire No. 8090 1-1/4 inch by 1-1/2 inch on lavatories.
   b. Provide McGuire No. 8089 1-1/2 inch by 1-1/2 inch on sinks.

4. Stops and Supplies: Provide stops and supplies of the same manufacturer as the fixture or faucet trim, or provide McGuire Model 170-LK loose key angle stop with 5 inch long 2

inch nominal copper sweat extension, bell escutcheon, and 3/8 inch O.D. by 12 inch flexible riser.

5. Sinks: Seamlessly drawn, self-rimming minimum 18 gauge, type 302 (18-8) nickel bearing stainless steel with 1-3/4 inch minimum rounded corners, satin finish, and fully undercoated.

6. Faucets: Chrome plated cast brass with stainless steel seats and monel stems. Gooseneck spouts shall be interchangeable and convertible rigid/swing type. Handles shall be interchangeable with square handle broachings.

7. Flushometers: Diaphragm operated cast-brass body, brass or copper pipe or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker. The flush valve shall be electric sensor operated with true manual override feature.

8. Water Conservation: Provide water conserving fixtures (Water sense labeled) and trim incompliance with the following maximum water use requirements. Provide Omni or equal variable pressure flow controls on sinks, and lavatory faucets.

   a. Public lavatories: 0.35 gpm
   b. Sinks: 1.5 gpm
   c. Water Closets: 1.1 gallons per flush.
   d. Urinals: 0.125 gpf

9. Fixture Supports: Provide floor mounted fixture support carriers for wall mounted fixtures including but not limited to: water closets, lavatories, scrub sinks, urinals, and clinical sinks.

10. Fixture carriers shall support at least 250 pounds on the front rim of the fixture for 5 minutes.

    a. Water Closets: Jay R. Smith Series 200-Y
    b. Urinals: Jay R. Smith 637.
    c. Lavatories: Jay R. Smith 700-M31.
    d. Wheel Chair Lavatories: Jay R. Smith 700-27-M31.

11. Toilet Seats: Provide extra heavy-duty, commercial/industrial type, elongated, open front, solid white injection molded plastic with integral bumpers; and self sustaining stainless steel check hinges.

    a. Acceptable Manufacturers: Bemis, Beneke, or Church.

12. Handicap Lavatory and Sink Insulation: Shall be provided on water supplies and waste piping below handicapped use lavatories and sinks.

    a. Acceptable Manufacturers: McGuire, TCI Products or Truebro.

C. Fixture Description

1. <u>P-1A (Barrier Free)</u> HET Water Closet, Equal to American Standard Model Afwall Millenium 2859.11. Vitreous china wall hung, white, elongated wall outlet water closet, 1.1 GPF, 1-1/2" top spud. Toilet flush valve to be water sense labeled, Manual 1.1 gpf flushometer. Equal to American Standard 6047.111.002. Provide combination drainage fitting and chair carrier to suit. Extra heavy duty solid plastic seat with check hinges (open front). Water closet shall be in compliance to the applicable section of ASME A112.19.2/

CSA B45.1, Mounting height to be 17" in accordance with architectural barriers board.

2. P-1B Water Closet (Child Care) Water Closet equal to American Standard Baby Devoro Flowise 2282.001, Floor mounted, white vitreous china, round bowl, high efficiency, 10.25" rim height, 1 ½" inlet spud, Toilet flush valve to be water sense labeled, manual 1.28 gpf flushometer. Equal to American Standard 6047.121.002. Provide toilet seat for baby Devoro bowl 5001G.005 or equal. (open front). Water closet shall be in compliance to the applicable section of ASME A112.19.2/ CSA B45.1

3. P-2 Urinal: Wall hung, 0.125 gpf vitreous china, top spud urinal equal to American Standard model Maybrook Universal 6581.00EC. The Flush valve to be water sense labeled, manual 0.125 gpf equal to American Standard 6045.013.002.

4. P-2A Urinal (Barrier Free) Same as P-2, except mounting in accordance with architectural barriers board.

5. P-3A : American Standard Murro Universal Design 0954.00 wall hung lavatory, ASME A112.19.2; vitreous china, wall hung wheel chair lavatory, 22" deep x 21.25" wide with 4" center faucet hole, Bowl size 15.5"x13.5"x 5", concealed arm brackets. Deck Mounted 4" fixed centers touch free faucet, (lead free), 0.35 gpm aerator. Faucet to be equal to Chicago Faucets Model EQ-A11A-KJKABCP. Provide Trim Plates, Chrome Plated brass grid strainer w/ 1 ¼ outlet tube. Mounting height in accordance with architectural elevation drawing. Provide knee guard insulation kit for trap and supplies. Coordinate mounting height with architectural elevation drawing. Provide ADA compliant offset drain with grid and knee guard insulation kit. Provide point of use thermostatic mixing valve at each faucet.

6.

7. P-3B : American Standard Murro Universal Design 0954.00 wall hung lavatory, ASME A112.19.2; vitreous china, wall hung wheel chair lavatory, 22" deep x 21.25" wide with 4" center faucet hole, Bowl size 15.5"x13.5"x 5", concealed arm brackets. Deck Mounted 4" fixed centers metering faucet, (lead free), 0.35 gpm aerator. Faucet to be equal to Chicago Faucets Model 3500-4E39PABCP. Provide Trim Plates, Chrome Plated brass grid strainer w/ 1 ¼ outlet tube. Mounting height in accordance with architectural elevation drawing. Provide knee guard insulation kit for trap and supplies. Coordinate mounting height with architectural elevation drawing. Provide point of use thermostatic mixing valve at each faucet.

8. P-4: Countertop Sinks:
Stainless Steel Sink (Barrier Free) Elkay Manufacturing Co. Model LRAD-1918, 19" x 18" x 5" deep ledge type, 18 gauge, type 304 18-8 stainless steel. Interior and top surfaces polished to polished finish, sound deadened with self-rimming feature. Chicago No. 50-TGN8AE3ABCP lead free faucet, fixed gooseneck spout, lever handles, 1.5 gpm E35 aerator, flow control fittings. McGuire mfg. 1151 AWC pre-wrapped 1 1/2 offset tailpiece with 151 stainless steel basket strainer offset rear. McGuire mfg. 165LK loose key stops with supplies McGuire 8089 CP 1 1/2" x 1 1/2" cast brass "P" trap with cleanout. McGuire 2127 CP IPS nipple to cast set screw flange 2127. Provide Deckmounted eyewash station with swivel spray heads equal to Guardian Model G1893. Provide ANSI Z358.1-2014 thermostatic mixing to deliver hot and cold water to deliver warm water. Product equal to guardian model G3600LF.

9. P-5A: Countertop Sinks:
Stainless Steel Sink Elkay Manufacturing Co. Model LRAD-1918, 19" x 18" x 5" deep ledge type, 18 gauge, type 304 18-8 stainless steel. Interior and top surfaces polished to polished finish, sound deadened with self-rimming feature. Chicago No. 786-

GN8AE35ABCP lead free faucet, fixed gooseneck spout, 369 handles, 1.5 gpm E35 aerator, Drinking fountain bubbler Chicago 748-244, flow control fittings. McGuire mfg. 1151 AWC pre-wrapped 1 1/2 offset tailpiece with 151 stainless steel basket strainer offset rear. McGuire mfg. 165LK loose key stops with supplies McGuire 8089 CP 1 1/2" x 1 1/2" cast brass "P" trap with cleanout. McGuire 2127 CP IPS nipple to cast set screw flange 2127. Provide point of use thermostatic mixing valve equal to Chicago Faucet model 131-CABNF.

10. P-5B: Countertop Sinks:
Stainless Steel Sink Elkay Manufacturing Co. Model LRAD-1918, 19" x 18" x 5" deep ledge type, 18 gauge, type 304 18-8 stainless steel. Interior and top surfaces polished to polished finish, sound deadened with self-rimming feature. Chicago No. 786-GN8AE35ABCP lead free faucet, fixed gooseneck spout, 369 handles, 1.5 gpm E35 aerator, Drinking fountain bubbler Chicago 748-244, flow control fittings. McGuire mfg. 1151 AWC pre-wrapped 1 1/2 offset tailpiece with 151 stainless steel basket strainer offset rear. McGuire mfg. 165LK loose key stops with supplies McGuire 8089 CP 1 1/2" x 1 1/2" cast brass "P" trap with cleanout. McGuire 2127 CP IPS nipple to cast set screw flange 2127. Provide point of use thermostatic mixing valve equal to Chicago Faucet model 131-CABNF.

11. P-6: Hi-Lo Electric Water Cooler Halsey Taylor Barrier-Free Water Cooler, Model HTHB-HAC8BLPV-WF with Bi level ADA cooler and Bottle filling station. The water cooler shall include filter, and certified NDF/ANSI 42 and 53 for lead free chiller unit and Platinum Vinyl finish. Cooler shall provide 8 gph of 50 degree F water at 90 degree F inlet water. Shall have vandal resistant bubbler and front pushbutton activation. Shall comply with ADA standards, U.L listed and be certified to lead free compliance including NSF/ ANSI 61. The Bottle filling Station shall be sensor activated for no touch activation with 20 second shut off timer. The bottle filler shall provide 1.5 gpm of laminar flow and consists of components to prevent mold and mildew.
Provide drain with 1 1/2 P-trap and mounting bracket. Refer to architectural drawings for mounting heights. Provide cane touch apron where indicated on drawing.

12. P-7: Floor Service Sink: Mop Receptor Fiat precast terrazzo mop basin, 24" x 24" x 12" with 6" drop front, stainless steel threshold, flange on wall sides. Fiat Model TSB-3010. Chicago 897 wall mounted service sink faucet w/ vacuum breaker spout. Wall hook, 24" long mop hanger with 3 spring clips. Provide 6' stainless steel braded water supply hose with pressure bleeder device and dual vented check valve (ASSE1055B approved) for secondary back flow preventer to soap dispenser connection. Installation shall be as per the plumbing code requirement.

13. P-7A: Wall Hung Service Sink: Equal to American Standard Model # 7695.018, Enameled cast iron, 24" X 20-½" complete with rim guard, drilled back on 8" centers and #7798.176 P-trap, 3" outlet, floor support with strainer. Faucet shall be equal Chicago Model 956-RCP with #369 lever handle, 8" centers with vacuum breaker. Provide 6' stainless steel braded water supply hose with pressure bleeder device and dual vented check valve (ASSE1055B approved) for secondary back flow preventer to soap dispenser connection. Installation shall be as per the plumbing code requirement.

2.11 GAUGES AND THERMOMETERS

A. General
1. Gauges and thermometers shall be as manufactured by U.S. Gauge Ashcraft, Trerice or equal.

2. The accuracy of all gauges and thermometers shall be within one percent of the scale range.

3. Thermometers shall be located at all water heater outlets and on all hot water return after immersion aquastat. Provide copper separable socket and socket wells.

B. Pressure Gauges (At Water Meter)

1. Gauges shall be installed with suitable "T" handle gauge cocks to permit servicing. Unless otherwise specified herein, all gauges shall be 5-inch diameter, dial type, stainless steel case aluminum peaker ring, phosphor bronze, bourdon tube, 1/4 inch forged brass N.P.T. male socket connection with wrench flats, white lithographed steel dial with black numbers and graduation. Dial graduations reading in "PSIG" shall be such that the normal operating pressure shall be indicated near the middle of the scale.

C. Thermometers: (At Hot Water Heaters and Master mixing valve)

1. Thermometers without mercury type. The Thermometer shall be graduated to "degrees F" and shall have a range so that the normal operating temperature shall be in the middle of the scale.

2. The face of the thermometer shall be large enough so it may be read from the floor.

2.12 VACUUM BREAKERS AND PRESSURE GAUGES

A. Approved vacuum breakers shall be installed with any plumbing fixture or equipment in which the potable supply outlet may be submerged and which cannot be protected by the minimum air gap. This includes all fixtures with hoses or a means for attaching hoses.

B All vacuum breakers shall be certified by a recognized testing laboratory acceptable to the Administrative Authority.

C. Vacuum breakers shall be installed with the critical level at least six inches (6")above the fixture they serve and on the discharge side of any control valve.

D. Pressure gauges shall be brass or stainless steel case, and shall be four inches (4") in diameter with a range of 0 to 150 psi, as manufactured by U.S.Gauge, Ashcraft or Omega. Furnish gauge cocks on all gauge connections to permit removal and/or repair without shutting down systems. All gauges shall also be equipped with "snubbers" or shall be liquid fill

2.13 ACCESS PANELS

A. Furnish access doors and frames for walls and ceilings to General Trades Subcontractor for installation. Size as required for access and maintenance, minimum 18 by 18 inches. Refer to specification section 08 31 10 ACCESS DOORS AND FRAME.

2.14 HOT WATER CIRCULATING PUMPS

A. General: Hot water circulating pump shall be as manufactured by Bell and Gossett Co., Taco, Thrush or approved equal

B. Provide where indicated an in-line hot water circulating pump, 1 all bronze with bronze impeller with capacity as shown on the schedule on drawing P0.01

C. The recirculation pump shall be enable and disable by means of immersion aquastats with visible scales and detachable wells which shall be installed in the recirculation lines and shall be so designed and connected that when the water temperature in the 140 degree F recirculating line drops to 115 degrees F, the pump shall start and when the temperature reaches 135 degrees F, the motor shall stop and when the water temperature in the 105 degree F recirculating line drops to 90 degrees F, the pump shall start and when the temperature reaches 100 degrees F, the motor shall stop.

2.15 WATER TEMPERING VALVES

A. Thermostatic Master mixing valve (TM-1 in Mech. room) : Complete Water Temperature Control station to maintain the return water temperature within the range off 100 degree F to 140 degree F. Valve must compensate for temperature fluctuation due to inlet temperature or pressure changes. Wetted surface of the product must comply lead free requirements and state code. The large and small mixing valve shall be equipped with adjustable high temperature limit stop set, color coded dial, locking temperature regulator, inlet union angle strainer checkstops. All bronze, brass and stainless steel construction. The station shall be preassembled and tested for complete control station and ASSE 1017 listed and shall be capable to interface with building management system.. The station shall include return circulator as specified on schedule, aquastat, automatic balancing valve and bypass line. The temperature control mixing valve shall be equal to Leonard model TM-420B-LF-DT

B. Point of use mixing valve for Lavatory (P-3A,B)and Sink (P-5A,B) faucets: Lead free, Thermostatic Mixing Valves with bronze body, Thermostatic wax element design, locking temperature adjustment knob, integral check valves on inlets and ball shut off valve. Minimum flow 0.35 gpm and maximum flow 4.6 gpm. Mixing valve shall be equal to Chicago Faucets 131 ABNF / 131 CABNF or equal.

C. Tempering valves shall be as manufactured by Powers, Symmons, Leonard or equal.

2.16 WATER HEATER (EWH-1)

A. Electric Domestic Water Heaters (EWH-1): Provide Hybrid electric heat pump for hot water heater generating unit.
B. Product shall be equal to A.O Smith Voltex Hybrid Electric Heat pump. Other equal manufacturers are HTP and Rheem.
C. The water heater shall adsorb ambient heat from the surrounding air to heat using 134a refrigerant compressor.
D. ASME rated temperature and pressure relief valve.
E. Automatically adjusts between compressor and elements to maintain the water temperature.
F. Furnish with dual anode rod for additional protection.
G. User friendly electronic interface to allow easy temperature control setting.

2.17 TRAP PRIMERS

A. The trap primer shall be as manufactured by Precision Plumbing Products, Inc., Jay R. Smith, MIFAB or approved equal.
B. Furnish and install trap primer units to serve one or two drains. Provide trap primers to all floor drains as required by 248 CMR Plumbing code.
C. For one or two floor drains, the trap shall be Precision Plumbing Products, Inc. Model P2-500, 1/2" connections, automatic brass trap primer units which shall be activated by a drop in water pressure (minimum 3 psi) in the active cold water line in which attached. Units shall meet Code and ASSE Standard #1018. Units shall be adjustable to line pressure and desired delivery amount. Units shall deliver a maximum of two ounces of water on a 15 second pressure drop and have corrosion resistant brass fittings with a copper reservoir with clear plastic inspection cover, and mounting brackets, “O” ring seals.

2.18 FIRE STOPPING

A. Refer to Division 07, Section 07 84 13 PENETRATION FIRESTOPPING.
B. Seal openings of fire rated construction with a material or product that has been tested at an independent

testing laboratory, such as UL, FM, etc. Fire stopping shall conform to ASTM E-814 and UL 1479, with fire ratings equal to or exceeding the fire rating of the construction involved. Fire stopping shall be UL classified, and shall be similar to the 3M brand Fire Barrier Penetration Sealing Systems, GE Silicones, Calpico Inc or approved equivalent. Fire stopping of this type shall also be utilized for openings through smoke rated construction.

C. Smoke proof and Seal all plumbing pipe penetration in corridor wall regardless it is rated or unrated wall construction.

2.19 SLEEVES AND PENETRATIONS

A. Piping penetrations through fire rated construction shall comply with a listed fire rated assembly as detailed in the UL Fire Resistance Directory. Pipe sleeves through floors, exterior walls and fire-rated construction shall be galvanized Schedule 40 steel pipe. Pipe sleeves through non-fire-rated partitions shall be 26 gauge galvanized steel.

1. Sleeves Through Exterior Below Grade Foundation Walls and Floor Slabs on Grade: Provide galvanized Schedule 40 steel with continuous weld slop on welding flange water stop. Provide waterproof caulking assembly by Link-Seal or Sure-Seal.

2. In areas where pipe is exposed, install sleeves flush with the finish floor, except in mechanical rooms, and janitor's closets extend sleeves at least 4 inches above finish floor.

3. Annular Space Requirements: Sleeves shall be sized to provide a total clearance of approximately 1 inch around pipe including insulation cover. Annular space around fire rated through penetrations assemblies shall be in compliance with the Listed Assembly.

4. Packing between the pipe and sleeve in fire rated construction shall be a combination of listed insulation and fire-proof caulk.
5. All penetrations for fire protection elements through fire rated partitions shall be firestopped by the Fire Protection Subcontractor. All penetration for fire protection elements through non-rated partitions shall be sealed with mineral wool insulation and acoustical sealant by the Fire Protection Subcontractor

B. Where piping passes below grade beams and footings, provide a ductile iron sleeve three sizes larger than the pipe being served. Sleeve shall be a minimum of six feet in length.

2.20 VALVE TAGS

A. Upon completion of piping installation work provide valve tags on all valves installed under the work of the mechanical sections. Valve tags shall be at least 1-1/2 inch diameter brass or engraved plastic with 1/4 inch high lettering for service designation over 2 inch high consecutively numbered valve identification. Engraved valve tags shall be color coded as specified for piping identification. Coordinate valve tag numbers with the City of Woburn’s facility management program. Provide service designation prefix as scheduled:

1. Plumbing Systems: Prefix:

a.	Domestic Cold Water	CW
b.	Domestic Hot Water	HW
c.	Domestic Hot Water Circulation	HWR
d.	Normally Closed	NC
e.	Unsafe Water	NP

B. Valve tags on plumbing systems may be engraved laminated plastic tags color-coded to match the pipe identification marks.

C. Identify Non-Potable water outlets with permanently attached yellow color-coded marker or 4-inch high triangle tag reading: Water Unsafe.

2.21 PIPING IDENTIFICATION

A. Provide matching flow arrows to indicate direction of flow. Markers shall be equal to Seton Setmark. Pipe marking for outside diameters of 6 inches or greater may be springs or metal bands secured to the corners at each end of the semi-rigid plastic marker to hold each end of the marker firmly against the pipe.

1. Color coding and size of legend letters shall comply with the standards of ANSI A13.1.

2. Provide markers with legend letters sized in compliance with the following schedule:

Outside Diameter (Over Insulation)	Size of Letters:	Length of Color Code:
1-1/4 inch and smaller	2 inch	8 inches
1-1/2 inch to 2 inch	3/4 inch	8 inches
2-1/2 inches to 6 inches	1-1/4 inch	12 inches
8 inch	2-1/2 inch	24 inches
10 inch and larger	3-1/2 inch	32 inches

3. Plumbing Systems: Provide color-coded identification markers in compliance with the following schedule with contrasting legend letters.

Service	Identification	Color Code
Cold Water	Dom. Cold Water	Green
Hot Water	Dom. Hot Water	Yellow
Hot Water Return	Dom. Hot Water Return	Yellow
Soil or Waste	Sanitary	Green
Vent	Plumbing Vent	Green
Rainwater	Storm	Green

2.22 IDENTIFICATION OF EQUIPMENT

A. Equipment: Stencil equipment such as pumps, water heaters, and tanks with the name of the equipment and equipment number. Coordinate equipment numbers with the User Agency's maintenance personnel. Stencils shall be at least 6 inches high and of a color to provide a contrast with the equipment finish.

B. Equipment markings shall be prominently displayed on each normally visible side of equipment. Equipment intended for installation in finished area shall have markings located behind normally used access panels mounted so as to be readily found. Equipment identification designations shall be taken from equipment schedules as indicated on the Drawings.

PART 3 – EXECUTION

3.1 IDENTIFICATION

A. All equipment and each length of pipe fitting, trap, fixture, control panel, starter and device used in the systems shall have a permanently attached nameplate or be cast, stamped or indelibly marked with the manufacturer's mark or name, the weight, type and class. The nameplates shall be kept clean and readable at all times.

B. Painting

1. Finished field painting of designated plumbing works shall be performed under Section 09 91 00 – PAINTING.
2. All unpainted, non-insulated, non-galvanized, ferrous metal surfaces only of conduits, pipes, equipment, hangers, supports, accessories, and so forth, furnished and installed by Plumbing Subcontractor, shall be painted as follows by Plumbing Subcontractor. Concealed and Exposed - one prime coat of metal primer. Underground - two coats of black asphaltum paint.
3. Surfaces which shall be inaccessible for painting after installation shall be painted before installation.
4. Surfaces to be painted shall be thoroughly cleaned of all scale, rust, dirt, oil and other foreign matter and shall be completely dry before applying paint.
5. After installation, equipment and accessories with factory primed or finished surfaces shall be cleaned, and bare or marred spots refinished and/or touched up by each Subcontractor with the same type paint and process as applied at the factory.
6. Nameplates on all equipment shall be cleaned and left free of paint.
7. Materials and workmanship shall be equal to the requirements specified under Section 09 91 00 – PAINTING.

3.2 CROSS CONNECTION PROTECTION AND APPROVALS

A. Protect potable water piping outlets and connections to equipment or machinery against backflow with an air-gap or approved backflow preventer.

B. Backflow preventer type, application, and installation shall comply with the Commonwealth of Massachusetts, Department of Environmental Protection (DEP) Drinking Water Regulations 310 CMR 22.00.

C. Prior to installation, the Plumbing Subcontractor shall submit through Designer, a design data sheet, with plans showing the method of protecting the water system, and secure approval from the (cross connection control division) local water authority, or its designee. This shall not be done until the Plumbing Subcontractor has secured the plumbing permit for the work, by the Inspector of Plumbing, and shop drawings have been reviewed.

D. Immediately upon installation, the Plumbing Subcontractor shall have the backflow preventer tested by a “Certified Backflow Prevention Device Tester”, and the results recorded on the water authority’s forms. Within 14 days after the installation, the Plumbing Subcontractor shall notify, through the Designer, the reviewing authority to arrange inspection of the installation. Submit copies of all paperwork to the water authority and the Designer, through the Project Manager.

E. Three (3) copies of each application and all subsequent correspondence, including the final permit, shall be forwarded to the Designer for record. Availability of final approval or permits shall be prerequisite to scheduling a final inspection of the plumbing work.

F. Mount backflow prevents horizontal at heights and with clearances as required by DEP regulations.

1. Reduced pressure backflow preventers shall be installed between 36 inches to 48 inches above the floor with a minimum of 12 inches clear space from back wall and 3'0" in front.

2. Provide indirect waste piping with funnel to receive discharge from reduced pressure backflow preventer atmospheric vents and spill through air gap into floor drain.

3.3 DISINFECTION, CLEANING AND ADJUSTING

A. Disinfection

1. Each potable water system (cold and hot water) shall be cleaned and disinfected by Plumbing Subcontractor. Cleaning and disinfection shall be performed after all pipes, valves, fixtures and other components of the systems are installed, tested and ready for operation.

2. All hot and cold water piping shall be thoroughly flushed with clean potable water, prior to disinfection, to remove dirt and other contaminants. Screens of faucets shall be removed before flushing and re-installed after completion of disinfection.

3. Disinfection shall be done using sodium hypochlorite in the following manner:

a. A service cock shall be provided and located at the water service entrance. The disinfecting agent shall be injected into and through the system from this cock only.

b. The disinfecting agent shall be injected by a proportioning pump or device through the service cock slowly and continuously at an even rate. During disinfection, flow of disinfecting agent into main water supply is not permitted.

c. All sectional valves shall be opened during disinfection. All outlets shall be fully opened at least twice during injection and the residual checked with ortho to lidin solution.

d. When the chlorine residual concentration, calculated on the volume of water the piping shall contain indicated not less than 50 ppm (parts per million) at all outlets, then all valves shall be closed and secured.

e. The residual chlorine shall be retained in the piping systems for a period of not less than 24 hours.

f. After the retention, the residual shall be not less than five parts per million. If less, then the process shall be repeated as described above.

g. If satisfactory, then all fixtures shall be flushed with clean potable water until residual chlorine by orthotolidin tests shall be not greater than the incoming water supply. (This may be zero.)

4. All work and certification of performance shall be performed by approved applicators or qualified personnel with chemical and laboratory experience. Certification of performance shall indicate:

a. Name and location of the job and date when disinfection was performed.
b. Material used for disinfection.
c. Retention period of disinfectant in piping system.

d. ppm chlorine during retention.
e. ppm chlorine after flushing.
f. Statement that disinfection was performed as specified.
g. Signature and address of company or person performing disinfection.

5. Upon completion of final flushing (after retention period) the plumbing subcontractor shall obtain a minimum of one water sample from each hot and cold water line and submit samples to a State-approved laboratory. Samples shall be taken from faucets located at highest floor and furthest from meter or main water supply. The laboratory report shall show the following:

   a. Name and address of approved laboratory testing the samples.

   b. Name and location of job and date the samples were obtained.

   c. The coliform organism count. (An acceptable test shall show the absence of coliform organisms.)

6. If analysis does not satisfy the above minimum requirements, the disinfection procedure shall be repeated.

7. Before acceptance of the systems, Plumbing Subcontractor shall submit to Designer for his review, three (3) copies of Certification of Performance as specified above.
8. Under no circumstances shall Plumbing Subcontractor permit the use of any portion of domestic water systems until properly disinfected, flushed and certified.

B. Cleaning and Adjusting

1. The work shall include all labor, tool, equipment and related items as may be required for the complete cleaning of waste and storm underslab piping.
2. Cleaning equipment may consist of hydraulic high pressure jet machines, heavy duty power rodding machines capable of cleaning distances, brushes, scrapers swabs or similar devices.
3. The cleaning equipment utilized shall be capable of removing all sand, dirt, rock and other debris from drain pipes.
4. Power rodding equipment shall have a capability of spinning the rod and shall also be also be capable of pushing or pulling the rod.
5. All cleaning equipment, including machines, devices, tools, etc. required for the entire cleaning operations shall be owned or leased and operated by the contractor.
6. All safety precautions outlined in general requirement of Div. 1 shall be followed by the contractor during cleaning operations.
7. After cleaning, perform video inspection of underground plumbing piping to evaluate any standing water or debris that may left during construction.
8. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by operation of the system for testing.

9. Any stoppage or discoloration or other damage to parts of the building, its finish, or furnishings due to the Plumbing sub contractor's failure to properly clean the piping system shall be repaired by this Plumbing Subcontractor at no increase in Contract costs.

10. At the completion of the work, all water systems shall be adjusted for quiet operation.

11. All automatic control devices shall be adjusted for proper operation.

12. All plumbing fixtures and exposed metal work shall be cleaned and polished. Floor drain strainers and traps shall be cleaned of all debris.

13. All items of equipment shall be thoroughly inspected. Any items dented, scratched or otherwise damaged in any manner shall be replaced or repaired and painted to match the original finish. All items so repaired and refinished shall be brought to the attention of the Designer and Project Manager for inspection and approval.

3.4 SYSTEMS

A. Sanitary Waste and Storm Drainage System

1. The Plumbing subcontractor shall be responsible for checking each pipe for alignment, center line elevation and invert grade for underground installations.

2. At times when work is not in progress, open ends of pipe and fittings shall be securely closed to the satisfaction of the Project Manager so that no trench water, earth or other substance shall enter the pipe or fittings. Any section of a building drainage system that is found defective in material, alignment, grade or joints before acceptance shall be corrected to the satisfaction of Project Manager. Pipe laid through rock excavation shall rest on a six-inch layer of well-compacted sand.

3. The sanitary (soil, waste and vent), storm drainage piping three inches and smaller in diameter shall pitch a minimum of 1/4 inch per foot. Piping four inches and larger in diameter shall pitch a minimum of 1/8 inch per foot.

4. The soil, waste and vent stacks shall be connected as shown and extended through the roof a minimum of 24 inches. Soil, waste and vent pipes shall be concealed unless otherwise noted.

5. Branch connections to each drainage system shall be made with "Wye" and long turn "Tee Wye" fittings. Installation of short radius 1/4 bends, common off-sets, double hub fittings and saddles shall not be approved. Installation of short "Tee Wye" fittings shall be permitted for vertical piping only, and only where space conditions shall not permit the use of long turn fittings. Only fittings conforming to the Code shall be installed.

6. The changes in direction of each drainage system shall be made with "Wye" branches and 1/8 bends. Provide long sweep bends at bottom of stacks with a vertical cleanout just above the floor at places where a "Wye" and 1/8 bends and end cleanouts cannot be installed.

7. Every fixture shall be separately trapped and the traps must be vented unless an approved battery vented system is being installed. Floor drains shall be considered as a fixture.

8. Vents shall be connected to the discharge of each trap in the sanitary system, thence carried individually to a point above the flood level of the fixture before connecting with any other vent pipes. Pitch the branch vents back to the fixture.

9. Collect individual vent pipes together in branch vent lines and connect to vent stacks. Wherever possible, vent stack offsets shall be made with 45 degree fittings. The vents passing through the roof shall be a minimum size of four inches in diameter.

10. Cleanouts shall be provided in drainage piping at changes in directions, at foot of stacks or other required points accessible for cleaning or rodding out.

11. Cleanouts shall be of the same size as the pipe installed in up to four inches in diameter and not less than four inches in diameter for piping larger than four inches in diameter.

12. The maximum horizontal distance between cleanouts in piping four inches in diameter and smaller shall not be more than 50 feet apart. In piping five inches in diameter and larger, cleanouts shall not be more than 100 feet apart.

13. Traps on sanitary piping not integral with fixtures and in accessible locations shall be provided with a brass trap screw protected by the water seal, and shall be regarded as a cleanout.

14. Test tees with brass cleanout plugs shall be provided at the foot of all vertical soil, waste and storm drainage stacks and at each floor. Wherever cleanouts on vertical lines occur concealed behind finished walls, they shall be extended to back of finished wall, and a wall plate shall be provided.

B. Cold and Hot Water Piping

1. Vacuum breakers shall be installed on supplies to each piece of equipment to prevent back-siphonage.
2. Branch lines from water service or main lines shall be taken off the top or bottom of main, using such crossover fittings as may be required by structural or installation conditions. All water service pipes, fittings, and valves shall be kept a sufficient distance from other work to permit finished covering to be not less than 1.5 inches from other work and not less than 1.5 inches between coverings on the different services.

3. Provide shock absorbers at special equipment, tops of the risers, at each individual or each group of fixtures.

4. Water piping shall be run parallel and graded evenly to the drainage points. There shall be a 2 inch drain valve provided for each low point in the piping so that all parts of each water system can be drawn off.

5. Provide suitable means of thermal expansion for the hot water piping using swing joints, expansion loops and long-turn offsets as required to suit building conditions.

6. Piping connections to equipment shall be provided with unions or flanges to permit convenient disassembly for alterations and repairs.

7. No piping shall be installed in a manner to permit back-siphonage or any flow of water from sanitary or drainage systems into the water systems or their distribution piping under any conditions.

8. Air gaps, open end of funnel drains, and approved vacuum breaking devices shall be provided as specified or as indicated on the Drawings. Piping to hose-end faucets or hose-end fittings, or any fixtures where water supply outlet is below the fixture overflow rim shall have vacuum breakers.

9. Where flanges are installed in the water systems, red rubber gaskets shall be installed between each pair of flanges.

10. Heating or bending of copper tubing to eliminate the installation of fittings shall not be permitted.

11. Piping systems shall be kept clean during all phases of work. Open ends of incomplete piping shall be protected to prevent the entrance of foreign materials.

12. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing.

13. Provide copper-plated friction clamps on the old water supplies to each water closet and urinal flushometer. Friction clamp shall be firmly clamped to the pipe and shall be firmly attached to the adjacent wall structure.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Piping Installation

1. Install piping approximately as shown on the drawings and as directed during installation by the Designer's representative.

2. Piping shall be installed as straight and direct as possible, forming right angles or parallel lines with building walls, other piping and be neatly spaced.

3. The horizontal runs of piping, except where concealed in partitions, shall be installed as high as possible.

4. Piping or other apparatus shall not be installed in such a manner as to interfere with the full swing of the doors and access to other equipment.

5. The arrangement, positions and connections of pipes, fixtures, drains, valves, and the like, indicated on the Drawings shall be followed as closely as possible.

6. It shall be possible to drain the water from all sections of each cold and hot water piping system. Pitch piping back to drain valves.

7. Screwed piping of brass or chrome-plated brass shall be made up with special care to avoid marring or damaging pipe and fitting exterior and interior surfaces.

8. Small fittings shall be taper thread. Lampwick, cord, wool or any other similar material shall not be used to make up thread joints.

9. Screwed pipe and copper tubing shall be reamed smooth before installation.

10. All exposed piping in connection with fixtures shall be chrome plated. Where chrome-plated piping is installed, cut and thread pipe so that no unplated pipe threads are visible when work is completed.

11. Reducing fittings, unless otherwise approved in special cases, shall be provided in making reduction in size of pipe. Bushings shall not be allowed unless specifically approved.

12. Remove and replace with new materials, any copper or brass piping (chrome-plated or unplated) showing visible tool marks.

13. Vertical risers shall be firmly supported by riser clamps, properly installed to relieve all weight from the fittings.

14. Any piece of pipe six inches or less in length shall be considered as a nipple.

15. All water service piping shall be kept a sufficient distance from other work to permit finished covering to be not less than 1.5 inches from other work and not less than 1.5 inches between the coverings (insulation) on the different services.

16. Underground piping, welding and welded joints shall conform to welding procedure detailed in AWWA Standard C206 for field welding water pipe.

B. Hanger Installation

1. All piping shall be supported from the building structure by means of approved hangers and supports, to maintain proper 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.

a. Maximum spacing of hangers on soil pipe shall be five feet and hangers shall be provided at all changes in direction. Vertical hanger rods to support piping from the structure or supplementary steel shall not exceed four feet in total length. Where pipe support assemblies exceed four feet in total length vertically, Plumbing Subcontractor shall provide factory fabricated channels and all associated accessories.

b. Friction clamps shall be installed at the base of the plumbing risers and at each floor (above or below floor slabs). Friction clamps installed above floor slabs shall not be supported from or rest on floor sleeves.

c. Provide hangers at a maximum distance of two feet from all changes in direction (horizontal and vertical) and on both sides of concentrated loads independent of the piping.

d. Hangers, in general, for all horizontal piping shall be Clevis type hangers. These hangers shall be sized to fit the outside diameter of the pipe insulation and insulation protectors (sheet metal shields) specified herein. For sprinkler/stand-pipe systems, hanger shall be approved black malleable iron, heavy duty pattern having two (2) parts bolted together.

e. All vertical drops and runouts including insulated pipes shall be supported by split ring hangers with extension rods and wall plates. These hangers shall be copper-plated when used on uncovered copper tubing. Supports on insulated vertical piping shall be sized to fit the outside diameter of the pipe insulation with 360 degrees insulation protector.

f. Provide on each horizontal insulated lines, pipe covering protectors (shields) at each hanger. Each protector shall be sized to fit the outside diameter of the pipe insulation.

g. Retaining straps shall be provided with all beam clamps.

h. All supplementary steel, including factory fabricated channels, associated accessories, and 12 inch long sheetmetal shields, throughout the project for this Section of the Specifications, both suspended and floor mounted, shall be provided by Plumbing Subcontractor and shall be subject to the approval of the Engineer.

i. Hangers shall not pierce the insulation on any insulated pipe.

j. Wire, tape or wood fastenings for shims or support of any pipe or tubing shall not be used.

k. Remove all rust from the ferrous hanger equipment (hangers, rods, and bolts) and apply one coat of red lead immediately after erection.

l. Piping at all equipment and each control valve shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

m. All piping shall be independently supported from the building structure and not from the piping, ductwork, conduit or ceiling suspension systems of other systems.

n. Installation of hangers which permit wide lateral motions of any pipe shall not be acceptable.

o. "C" clamps installed with pipe hangers or equipment hangers shall not be permitted unless provided with retaining straps.

p. All no-hub cast iron pipe 6 inches or larger in diameter shall be braced to prevent horizontal movement as recommended by the Cast Iron Soil Pipe Institute by using braces, blocking or rodding as illustrated in the CISPI Handbook, Vol. II, Specification Section 310.

C. Pipe Covering Installation

1. Before pipe covering is applied, all pressure tests shall have been performed and approved by the Local Plumbing Inspector.

2. Pipe covering shall be applied over clean, dry surfaces.

3. Pipe covering shall be continuous and shall be carefully fitted with side and end joints butted firmly and tightly together and finished as specified herein.

4. Pipe covering and auxiliaries shall be kept dry during storage and application.

5. Adhesives, cements and coatings shall not be applied when the ambient temperature is below 40 degrees Fahrenheit.

6. Valve bodies shall have covering applied up to the stem.

7. It is the intent of this Specification that all vapor barriers be sealed and be continuous throughout. Staples shall not be used on vapor barrier jackets.

8. Where pipe covering ends occur at equipment or fixtures, end caps on the covering shall be provided.

9. Adequate operating clearances shall be provided at control mechanisms.

10. Pipe covering for flanges shall overlap the adjoining pipe by a minimum of three inches on each side.

11. Pipe covering shall be provided on all piping passing through ceilings and through the interior above ground sleeves (wall and floor).

12. All voids and seams in insulation shall be filled with insulating cement and finished as specified herein.

13. End joints of each section of the installed pipe covering shall be tightly butted.

D. Installation of Sleeves, Inserts and Escutcheons (New and existing floors and walls)

1. Sleeves in floors shall be set one (1) inch above the finished floor surface or as indicated on the Architectural Drawings.

2. Sleeves through interior masonry or non-masonry walls or partitions shall be set flush with the finished surfaces of the wall or partition.

3. Field drilling for inserts required for work under this Section of the Specifications shall be provided by plumbing subcontractor.

4. Each interior wall or partition sleeve shall be packed with foam or glass wool to within one inch of each face of wall, and the remaining portion of each end of sleeve to be sealed with U.L. listed fire proof caulking compound equal to the rating of the partition.

5. Escutcheons shall be installed around all exposed insulated or bare pipe, except water closet starts or bends passing through a finished floor, wall or ceiling. Escutcheons shall fit snugly around the bare pipe or insulated pipe.

E. Valve Installation

1. Location of Valves: There shall be valves where indicated on the drawings and where specified as follows:

a. At building service entrances, foot of all supply risers, branches to groups of fixtures, branches to separate fixtures, equipment, wall hydrants, hose bibbs, connections to other systems and sectionalizing points in each system.

b. Each fixture supply shall have a separate angle stop or straight stop finished like the pipe it services.

c. Each piece of equipment shall have isolation valves for each service connected.

d. At the foot of each riser, on the inlet and outlet side of control valves.

e. At the low points of each water system including trapped sections, provide a tee with 2 inch branch and valve with 3/4 inch hose end adapter and attached chain with cap.

f. Valves shall be located to permit easy operation, replacement or repair.

F. Installation of Gauges and Thermometers

1. Thermometers and pressure gauges shall be installed in such a manner as to cause a minimum restriction to the flow in the pipes and so that they can be easily read from the floor.

2. Thermometers shall be installed in the outlet piping from the hot water heater.

3. Pressure gauges in the cold water system shall be installed at the water meter.

G. Sewer Connections

1. Connections to the site sewer within 10’ of the building shall be in accordance with local regulations. Coordinate sewer inverts with the site contractor

H. Drinking Water Cooling System Installation

1. General: Provide water cooler with a bracket which shall be securely anchored to the wall in a manner suitable for the wall construction and weight to be carried.

I. Pump Installation

1. General: Install plumbing pumps where indicated on the drawings in accordance with manufacturer's published installation instructions.

2. Access: Provide access space around plumbing pumps for service, but in no case less than that recommended by manufacturer.

3. Support: Install base-mounted pumps on minimum 4 inches high concrete base equal or greater than 3 times total weight of pump and motor, with anchor bolts poured in place. Set and level pump, grout under pump base with non-shrink grout. Install in-line pumps supported from piping system.

4. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Verify that electrical wiring installation is in accordance with manufacturer's requirements.

5. Piping Connections: Provide piping, valves, accessories, gauges, supports, and flexible connections as indicated on the drawings.

6. Alignment: Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.

7. Start-Up: Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions.

8. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

J. Domestic Water Heater Installation

1. General: Install domestic electric water heater in accordance with ANSI Z223.1 and the manufacturer's installation instructions.

2. Support: Install water heater on pads oriented so that controls and devices needing service and maintenance have adequate access. Install water heaters level.

3. Water Piping: Provide hot and cold water piping to units with shutoff valves and unions. Provide recirculating water line to unit with shutoff valve, check valve, and union.

K. Floor Drain Installation

1. Install floor drains in accordance with manufacturers written instructions and in locations indicated.

2. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with low point finished floor.

3. Trap all drains connected to the sanitary sewer.

4. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

5. Position drains so that they are accessible and easy to maintain.

L. Installation of Trap Primers

1. Install trap primers with piping pitched towards drain trap, minimum of 1/8 inch per foot (1 percent). Adjust trap primer for proper flow.

M. Roof Drain Installation

1. Install roof drains at low points of roof areas, in accordance with the roof membrane manufacturer's installation instructions.

2. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.

3. Position roof drains so that they are accessible and easy to maintain.

N. Blending Valve Installation

1. All piping shall be thoroughly flushed before the blending valve is installed. Insure that hot and cold water piping are connected to proper
2. Follow manufacturers instructions for setting of maximum allowable temperature limits allowed by code.

3. Valve must be flowing when setting temperature.

O. Installation of Pressure Reducing Valves

1. General: Install one or more pressure reducing valves on the main water line supplying plumbing fixtures.

   a. The total capacity of each assembly shall be not less than the capacity specified.

   b. Provide each pressure reducing valve with a gate valve and union on both the inlet and outlet connections.

   c. A bypass one pipe size smaller than the main water line provided with a globe valve and union, shall be installed between the inlet and outlet sides of the pressure reducing valve assembly.

   d. Pressure gauges shall be installed at the inlet and outlet connections to the pressure reducing valve assembly. Gauges shall have T-handle stops in their connections.

P. Strainer Installation

1. General: Place strainers ahead of pressure reducing valves, automatic control valves, pumps, and elsewhere as indicated on the drawings or specified.

Q. Installation of Cleanouts and Ferrules

1. Riser Connection to Sewer or Drain: Where soil, waste, or roof drainage risers connect to a sewer or drain extending from the building above the lowest floor, the fitting at the base of each stack or downspout shall be a sanitary tee or a combination Y and 1/8 bend with cleanout plug in the end of the run of the main.

2. Test Tees: Each vertical soil, waste, and vent pipe and each downspout and roof drainage pipe which connects to horizontal drain piping below ground shall be fitted with a test tee above the lowest floor or ground. Where accessible, test tee may be installed in the horizontal pipe at the base of the riser.

3. Cover Plates: Where cleanouts or test tees occur on concealed pipes in finished rooms, they shall be provided with a 1/8-inch thick, machine finished, brass cover plate of sufficient diameter to cover the opening in the finished wall or partition. The cleanout plug shall have a solid head, tapped for a 1/4-inch brass screw to secure the cover plate. Where cleanout plugs extend beyond the wall finish, the cover plates shall be of machine finished brass and shall be only of sufficient depth to fit against the wall to cover plug. Cleanout cover plates shall be painted to match adjacent wall finish.

4. Cleanouts Plugs For Threaded Fittings: Cleanout plugs for threaded fittings shall be in accordance with ANSI B16.12. Except for test openings, where size must be sufficient to admit test plug, bushings shall be permitted on pipes 5-inches and larger to reduce plug size to 4 inches; cleanout plugs for piping 4 inches and smaller shall be the same size as the pipe.

5. Cleanout Plugs For Hub-and-Spigot Fittings: Cleanout plugs for hub-and-spigot fittings shall be screwed into ferrules caulked into the fitting. Ferrules and plugs shall be in accordance with ANSI B16.12, except that plugs required to be flush with the floor shall have square countersunk heads in lieu of raised heads.

6. Cleanout Plugs For Copper Drainage Lines: Cleanout plugs on copper drainage lines shall be installed in solder-joint fittings having threaded openings provided for the cleanout, or in solder-joint fittings with threaded adapters.

R. Installation of Plumbing Fixtures

1. General:

   a. Refer to Architectural Drawings for locations and mounting heights of all plumbing fixtures, counter-sinks, water fountains and showers.

   b. Provide with all plumbing fixtures, all trim, supports, fittings, connections and all incidentals necessary to make a complete installation in accordance with plumbing codes and the Contract Documents.

   c. All visible hanger nuts and all escutcheons shall likewise be chrome-plated over nickel plate.

2. Examination:

   a. Examine roughing-in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.

b. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

c. Do not proceed until unsatisfactory conditions have been corrected.

3. Fixture Roughings

a. Install rough plumbing including fixture carriers and supports, valves and water hammer arrestors within chase tolerances. Supply roughing through finish walls and at hose bibbs and shower heads shall be secure and free of movement. Locate valves and water hammer arrestors within 12 inches of approved access panel location.

b. Align exposed waste and supply pipe roughings with fixture connections within 1 inch tolerance. Provide flush valves in alignment with the fixture, without vertical or horizontal offsets. Obtain fixture manufacturer roughing data sheets for recommended roughing dimensions.

c. Provide fixture templates for casework contractor for counter mounted sinks and lavatories.

1) Rough handicapped use water closets to locate the flush valve handle on the wide side of the toilet stall.

d. Secure fixture supports to floor slab construction with lag bolts and metal expansion shields to support at least 250 pounds on the front rim of the fixture for 5 minutes.

e. Mounting Heights: Coordinate with Architectural Details

4. Fixture Supports

a. All fixtures (including drinking fountains) shall be supported and fastened to the building structure. The method of support for each type fixture shall be specified herein, except when the fixture designations on the Contract Drawings indicate modifications.

b. Wall hung water closets shall be generally supported on combination drainage fittings and chair carriers and with foot supports fastened to the floor slab with expansion lag screws.

c. Urinals shall be supported by floor mounted carrier with support plate, bearing plate, adjustable extension, tubular uprights, block bases and chrome-plated trim.

d. Installations shall be complete with all necessary bolts, nuts and washers, iron or brass connecting nipples between fixtures and piping system of the proper length and graphite non-asbestos gaskets for closet connections.

e. Where wall hung fixtures are secured to masonry walls or partitions, they shall be fastened with 1/4 inch through bolts provided with nuts and washers at back. Bolt heads and nuts shall be hexagon and exposed bolts, nuts, washers and screws shall be chromium-plated brass.

f. Where secured to concrete or brick walls, they shall be fastened with brass bolts or machine screws in lead sleeve type expansion shields and shall extend at least

three inches into solid concrete or brick work, except fixtures specified to be supported or chair carriers.

5. Installation of Fixtures

   a. Mount fixtures level at elevations shown on architectural drawings. Refer to toilet room elevations and casework details.

   b. Install handicapped use fixtures in accordance with the requirements to the Architectural Access Board Code and ANSI A117.1. Insulate hot water supply and waste piping under lavatories.

      1) Where urinals are provided: Install one urinal with the rim mounted above the finish floor in compliance with the handicapped code. Coordinate architectural drawing for mounting height.

   c. Grout wall and floor mounted fixtures watertight where the fixtures are in contact with walls and floors.

   d. Caulk deck-mounted trim at the time of assembly, including fixture and casework mounted. Caulk self-rimming sinks installed in casework.

6. Fixture Trim:

   a. All materials specified to be chromium plated shall be thoroughly cleaned and polished before plating, and plate shall be heavily, thoroughly and evenly applied, guaranteed not to strip or peel.

   b. Where escutcheons are not furnished with plumbing fixtures, Plumbing Subcontractor shall supply them. Escutcheons shall be the type and material specified herein.

   c. Each fixture shall be separately trapped using the type and size of trap specified herein and required by the Plumbing Code.

   d. Unless otherwise specified, faucets and all exposed fittings shall be chromium plated. Chromium plating for brass shall be applied on a first plating of nickel.

   e. 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.

   f. All brass shall conform to brass tubing and shall be not less than No. 17 gauge.

7. Adjustments and Cleaning

   a. After completion of the installation work and equipment start-ups, perform the necessary adjustments to systems installed under this Section. Submit verification that systems are operating at the specified temperatures and pressures.

   b. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

   c. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.

d. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

e. Replace washers of leaking and dripping faucets and stops.

f. Adjust flush valves, open fixture stops, and clean faucet aerators.

g. Set aquastats on water heaters and circulation pumps.

h. Temperature adjustments: Adjust pressure balanced mixing valves at showers to provide a maximum temperature of 112 degree F. Adjust metering faucets in public toilet rooms to provide a maximum temperature of 110 degree F.

i. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

8. Protection

a. Provide protective covering for installed fixtures and fittings.

b. Do not allow use of fixtures for temporary facilities, except when approved in writing by Project Manager.

3.6 ELECTRICAL COORDINATION

A. The Electrical Contractor shall provide the power wiring (120V) to all equipment provided under the plumbing Sections of the specifications.

B. For systems which utilize central control panels, the Electrical Contractor shall connect power to the control panel. For systems which do not utilize central control panels, the Electrical Contractor shall connect power to the equipment manufacturer provided junction boxes or wiring points

C. For systems which utilize central control panels, the 220001 Sub-Contractor shall connect power from the control panel to the various components within the given system. The 220001 Sub-Contractor shall retain the services of a licensed electrical contractor to perform all required work. 220001 Sub-Contractor shall verify with each system vendor all electrical and control work required for the proper installation and operation of their respective systems, which has not included in the vendor’s price and include this work in his bid price. All conduit and wiring provided by The Section 220001 Sub-Contractor and his subcontractors shall be installed in accordance with the requirements of Division 26 -Electrical of these specifications.

D. Low Voltage Control Wiring: Provide 24 VAC control wiring from plumbing fixture controller to each controlled utility or device. Make connections at controlled device and terminate at output terminal on Controller. Minimum wiring, 18 AWG, plenum rated cable. Provide cable with required conductors plus two spares

3.7 INSPECTION AND TESTS

A. General

1. All labor, materials, instruments, devices and power required for testing shall be provided by the Plumbing Subcontractor. The tests shall be performed in the presence and to the satisfaction of the Designer and such other parties as may have legal jurisdiction. No piping in any location shall be closed up, furred in, or covered before testing and approval by the Local Plumbing Inspector and Project Manager.

2. Where portions of piping systems are to be covered or concealed before completion of the project, those portions shall be tested separately in the manner specified herein for the respective entire system.

3. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of Owner's Project Manager shall be retested in part or in whole as directed.

4. The Authority retains the right to request a recheck or resetting of any pump or instrument by the Plumbing Subcontractor during the guarantee period at no additional cost to the Contract.

5. Repair, or if directed by Project Manager, replace any defective work with new work without extra cost to the contract. Repeat tests as directed, until the work is proven to meet the requirements specified herein.

6. Restore to its finished condition any work, provided by other Contractors, damaged or disturbed by tests. The Plumbing Subcontractor shall engage the original Contractor to do the work of restoration to the damaged or disturbed work.

7. The fixtures shall be tested for stability of support and satisfactory operation. The piping shall be tested when directed by the Designer, Local Plumbing Inspector for stability of support.

8. After the fixtures are set and connected, and the piping systems to same have been tested, the Plumbing Subcontractor shall turn water on to the fixtures, equipment, fill the traps, etc., and the proper operation of all items shall be demonstrated by him in the presence of and to the satisfaction of the Engineer, Owner's Project Manager, Plumbing Inspector, or their designated representative.

9. Caulking of screwed joints or holes in piping shall not be acceptable.

10. The Plumbing Subcontractor shall notify the Designer, Owner's Project Manager and all inspectors having jurisdiction, a minimum of 48 hours in advance of making any required tests so that arrangements may be made for their presence to witness scheduled tests.

B. Specific

1. Storm and Sanitary Piping Systems:

   a. Before the installation of fixtures, equipment and insulation, each system including vents shall have all necessary openings plugged to permit the entire system to be tested in accordance with the State Plumbing Code. Each system shall hold this water without a drop in water level. Test to be witnessed by Local Plumbing Inspector and Project Manager.

   b. Where a portion of the system is to be tested, the test shall be accomplished with a vertical stack ten feet above the highest horizontal line to be tested may be installed, and filled with water to maintain sufficient pressure. A pump may be used to supply the required pressure. The pressure shall be maintained for a minimum of four hours for sufficient time to permit inspection of all joints.

2. Cold and Hot Water Piping System:

a. Upon completion of the roughing-in and before setting fixtures and final connections to all equipment, all water piping systems shall be tested to a hydrostatic pressure of 150 pounds per square inch.

b. Each systems test shall be maintained for eight hours without a drop in pressure. These tests to be witnessed by Local Plumbing Inspector and Owner's Project Manager.

c. After testing, provide complete adjustment of all parts of each water system until design distribution or balancing is obtained throughout.

3.8 SPECIAL RESPONSIBILITIES

A. Coordination: Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed.

2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.

3. Obtain detailed installation information from manufacturers of equipment provided under this Section.

4. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by User Agency.

5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Designer.

6. Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for floor-mounted vibrating and rotating equipment provided under this Section.

7. Notify Designer of location and extent of existing piping, ductwork and equipment that interferes with new construction. In coordination with and with approval of Designer, relocate piping, ductwork and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned piping, ductwork and equipment as directed by Designer. Dispose of or store items as requested by Designer.

B. Installation Only Items

1. Where Plumbing Subcontractor is required to install items which it does not purchase, it shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This trade shall be responsible for:

a. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.

b. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

2. Plumbing Subcontractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation shall require procedures beyond the reasonable scope of work of Plumbing Subcontractor shall be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted Plumbing Sub contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

C. Maintenance of equipment and systems: Maintain Plumbing equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions. Do not use boilers before providing water treatment where required; this includes use of boilers for temporary heat or for testing.

D. Use of premises: Use of premises shall be restricted as directed by Designer and as required below.

1. Remove and dispose of dirt and debris, and keep premises reasonably clean. Upon completion of work, remove equipment and unused material. Put building and premises in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of Designer and as specified under CLEANING paragraph.

2. It shall be this trade's responsibility to store his materials in a manner that shall maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.

3. Do not interfere with function of existing sewers and water mains. Extreme care shall be observed to prevent debris from entering ductwork. Confer with Designer as to disruption of heating services or other utilities due to testing or connection of new work to existing. Interruption of heating services shall be performed at time of day or night deemed by Designer to provide minimal interference with normal operation. Obtain Designer's approval of the method proposed for minimizing service interruption.

E. Surveys and measurements:

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct laying out of work.

2. In event of discrepancy between actual measurements and those indicated, notify Designer in writing and do not proceed with work until written instructions have been issued by Designer.

3.9 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Piping shall run concealed except in mechanical rooms and areas where no hung ceiling exists. Install material and equipment as required by manufacturers. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and pipe openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents.

C. References to manufacturers and to catalog designation, are intended to establish standards of quality for materials and performance but imply no further limitation of competitive bidding.

D. Finish of materials, components and equipment shall be as approved by Designer and shall be resistant to corrosion and weather as necessary.

E. The owner will not be responsible for material and equipment before testing and acceptance.

3.10 UNDERGROUND PIPE CLEANING

A. The work shall include all labor, tool, equipment and related items as may be required for the complete cleaning of waste and storm underslab piping.

B. Cleaning equipment may consist of hydraulic high pressure jet machines, heavy duty power rodding machines capable of cleaning distances, brushes, scrapers swabs or similar devices.

C. The cleaning equipment utilized shall be capable of removing all sand, dirt, rock and other debris from drain pipes.

D. Power rodding equipment shall have a capability of spinning the rod and shall also be also be capable of pushing or pulling the rod.

E. All cleaning equipment, including machines, devices, tools, etc. required for the entire cleaning operations shall be owned or leased and operated by the contractor.

F. All safety precautions outlined in general requirement of Div. 1 shall be followed by the contractor during cleaning operations.

G. After cleaning, perform video inspection of underground plumbing piping to evaluate any standing water or debris that may left during construction.

3.11 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner’s Project Manager's approval.

B. Schedule interruptions in advance, according to Owner’s Project Manager's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on User Agency's operations.

3.12 ANCHORS AND INSERTS

A. Inserts shall be iron or steel of type to receive machine bolt head or nut after installation. Inserts shall permit adjustment of bolt in one horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

B. Provide anchors as necessary for attachment of equipment supports and hangars.

3.13 INSTALLATION OF EQUIPMENT

A. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to satisfaction of Designer and in accordance with code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

B. Install equipment so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof-mounted equipment shall be installed and supported on structural steel provided under other Sections.

C. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall or ceiling mounting of equipment provided under this Section (e.g. heating and ventilating units, fans, ducts and piping) as indicated on Drawings and in Specifications.

D. Provide steel supports and hardware for proper installation of hangers, anchors, guides, etc.

E. Provide cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.

F. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and hardware shall conform to requirements of Section Five of Code of Practice of American Institute of Steel Construction.

G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly which will void warrantee. Report in writing to Designer, prior to purchase or shipment of equipment involved, on conditions which may prevent proper installation.

3.14 COMMISSIONING OF EQUIPMENT AND SYSTEMS

A. The owner's commissioning agent will check the completed installation either sequentially as different parts are completed, or when the entire installation is complete, at the sole option of the Commissioning Agent.

B. Prior to the commissioning agent's checking a part of the installation or the entire installation, Plumbing Subcontractor shall submit a letter signed by the designated representative tht

1. he is a designated representative of the company,
2. he has personally inspected the installation to be checked,
3. the date of his inspection,
4. the installation is complete and tested and ready to be inspected by the Designer, and that all required test reports have been submitted.

C. Plumbing Subcontractor shall arrange that an officer of this contracting company or of the general contractor, as well as the commissioning agent and Owner's Project Manager, shall witnesses the necessary test, in addition to Plumbing Subcontractor's personal run the respective tests. At the conclusion of each such test Plumbing subcontractor shall submit a letter signed by the officer stating that:

1. he is an officer of the company,
2. he has personally witnessed the test (give the name of the test),
3. the date of testing,
4. the results of testing, as compared to specified performance,
5. listing the name, title, and company affiliation of all those witnessing the test.

3.15 PAINTING

A. Equipment shall have shop coat of non-lead gray paint. Hangers and supports shall have one coat of non-lead red primer. Complying with IEQ requirements specified under section 090007-Painting. Machinery such as pumps, fans, etc., shall be stenciled with equipment name. Stencil shall be at least 6" high for large equipment, 2" high for small equipment. Finish painting, including painting of various piping and duct systems, shall be done under other Sections.

3.16 SYSTEM SHUTDOWNS

A. Coordination shutdowns of existing systems with the Project Manager 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 effected 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.

3.17 CORE DRILLING

A. Do not core new or existing concrete structure without written approval from the Structural Engineer.

B. Perform all core drilling required for the proper installation of this Section. Locate all required openings and prior to coring. Coordinate the opening with the other Trades and obtain approval from the Structural Engineer.

C. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to cutting. Take care so as not to disturb the existing building systems. Damage to existing conditions incurred during core drilling shall be corrected to the Owner Project Manager's satisfaction with no additional expense to the contract.

3.18 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

1) Refer to Specification section 017700 Closeout Procedures

2) Training Preparation Conference: Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors. Perform the following:

1. Review installed systems, subsystems, and equipment.
2. Review instructor qualifications.
3. Review instructional methods and procedures.
4. Inspect and discuss locations and other facilities required for instruction.

B. Training Modules: Develop an instruction program that includes individual training modules for each system, subsystem, and equipment.

SECTION 230000

HVAC
(Filed Sub-Bid Required)

END OF INDEX

SECTION 230000

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 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: 23 00 00 – 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 or may be obtained by written or telephone request.

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:

1. Sub-bidders’ attention is directed to Massachusetts General Laws, Chapter 149, Section 44F as amended which provides in part as follows:

a. Each sub-bidder shall list in Paragraph E of the “form for Sub-bids” the name and bid price of each person, firm or corporation performing each class of work or part thereof for which (the Section of the specifications for that sub-trade) requires such listing; provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his/her own name in said paragraph E for any such class of work or part thereof and perform that work with persons on his/her own payroll; if such sub-bidder, after sub-bid openings, shows to the satisfaction of the awarding authority that s/he does customarily perform such class of work or the part thereof with persons on his/her own payroll and is qualified so to do. This Section of the Specifications requires that the following classes of work shall be listed in paragraph E under the conditions indicated herein.

CLASSES OF WORK	SECTION NUMBER
Insulation	2.4, 3.5
Sheetmetal	2.11, 2.12, 2.15, 3.12, 3.13, 3.16
Automatic Temperature Controls	2.20, 3.21
Testing & Balancing	3.22

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: M0.01, M1.00, M1.01, M1.02, M1.03, M1.04, M2.01, M2.02, M2.03, M3.01, M3.02, M3.03, M3.04, M3.05, M4.01, M4.02, VS.1.

1. Any scope specifically referenced on one of the drawings above and described on another drawing is also part of the scope of this filed sub-bid contractor.

E. The listing of the Contract Drawings above shall not limit the subcontractor's responsibility to determine the full extent of work of this Section as required by all Contract Drawings noted on the Contract Drawings including the Title Sheet Drawing List, the Project Manual, and Addenda.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DESCRIPTION OF WORK

A. 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.

B. Furnish all staging, rigging, temporary support, labor, materials, and perform all operations in connection with the installation of the HVAC work.

C. Without limiting the generality thereof, the work to be performed under this section includes complete new HVAC systems with the following major sub systems:

1. Condensate Drain Piping, Pumps, Insulation and accessories
2. Refrigeration Piping with insulation, valves, and hangers
3. Ductwork With Insulation, Diffusers, Registers, Grilles and Sound Attenuators.
4. Terminal Electric Heating Units including Unit Heaters, Fin-tube Radiation, Air Curtains, Radiant Ceiling Panels, and Radiant Wall Panels
5. 100% O.A. Rooftop Units
6. Sound Attenuators
7. Ductless Cooling Unit Systems
8. Direct Digital Automatic Temperature Controls
9. Variable Refrigerant Flow Simultaneous Heating/ Cooling system
10. Air Outlets and Inlets

D. Refer to Section 230548 "Vibration Control and Seismic Restraint" for additional work to be provided under this Section 230000.

E. Refer to Section 078410 - THROUGH PENETRATION FIRESTOP SYSTEMS for additional work to be provided under this Section 230000.

F. Include the following work as needed to perform the work of this section.

1. Core drilling in accordance with SECTION 017329 – CUTTING AND PATCHING.
2. Cutting through non masonry construction in accordance with SECTION 017329 – CUTTING AND PATCHING.
3. Temporary facilities, including but not limited to stairs and ladders, staging, scaffolding, chutes and hoisting in accordance with SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS.
4. Fire stop systems in accordance with SECTION 078410 – THROUGH PENETRATION FIRESTOP SYSTEMS.
5. Furnish access doors and frames in accordance with SECTION 083113 – ACCESS DOORS AND FRAMES.

G. Louvers specified in Section 089000 – LOUVERS AND VENTS to be furnished and installed by Division 23 00 00.

H. Change all air handling unit (RTU, UH, UV, FC, DCU) filters as required by SECTION 018120 – CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT flush out procedures and adhere to IAQ Management Procedures.

1.4 RELATED WORK UNDER OTHER SECTIONS

A. The following work is included in other sections. Coordinate the work of this section as required per those sections.

B. Cutting beyond the requirements as stated herein, and patching of all openings regardless of size, is specified in the respective Sections of the trade responsible for furnishing and installing similar new materials.

C. For temporary controls refer to Section 015000. If Owner authorizes use of the permanent HVAC system for temporary use during construction, provide temporary controls to adequately control the unit and not void the warranty. Coordinate extent of temporary controls with General Contractor. Provide temporary filters for this use and replace as required per Section 018119. Clean the internal components of the units and ducts prior to substantial completion.

D. For flashing of vents through roof and setting of roof curbs and flashing of such, refer to Sections 076200 & 075300.

E. For power wiring of mechanical equipment refer to Section 260000.

F. For excavation and backfill of below grade mechanical and related systems refer to Section 312000 – EARTHMOVING.

G. For structural steel refer to Section 051200.

H. For firestopping not called for in this Section refer to Section 078410.

I. For finished painting of mechanical systems not called for in this Section refer to Section 099000.

J. For interior concrete work relating to this Section refer to Section 033000.

K. For exterior concrete work relating to this Section refer to Section 033000.

L. Installation of hollow metal doors and frames refer to Section 081110 – HOLLOW METAL DOORS AND FRAMES.

M. For masonry work relating to this section, refer to SECTION 042000.

N. Change all air handling unit (RTU, UH, UV, FC, DCU) filters as required by SECTION 018120 – CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT and SECTION 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS flush out procedures and adhere to IAQ Management Procedures referenced in Sections 01 81 19 & 018120.

1.5 CODES, ORDINANCES, AND PERMITS

A. Perform all work in accordance with the requirements of Newton Building Department, State of Massachusetts Building Code, 9th Edition, and applicable State and Federal Laws. Give all requisite notices, file all requisite plans, and obtain all permits required to perform HVAC Work.

B. Permits: Be responsible for filing documents, and securing of inspection and approvals. Pay all local connection & permit fees. Costs related to temporary service, refer to Section 015000. Refer to AIA 201 General Conditions.

C. All HVAC equipment shall be installed to meet all State, Local and Federal sound ordinances.

1.6 QUALITY ASSURANCE

A. Codes and Standards:
1. ANSI Standards: Comply with ANSI A13.1 for pipe, valve, and equipment identification.
2. FM Compliance: Provide control devices and control sequences in accordance with requirements of Factory Mutual System (FM).
3. IRI Compliance: Provided control devices and control sequences in accordance with requirements of Industrial Risk Insurance (IRI).
4. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards.
5. 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.
6. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
7. 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".
8. 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.
9. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

B. Automatic Temperature Control Contractor Qualifications: Branch Factory Owned Authorized dealers specializing in manufacturing and installation of control system for not less than 10 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. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.7 HAZARDOUS MATERIALS

A. The HVAC 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 to be removed and/or demolished.
4. Items specifically noted on drawings.

1.8 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 manufacturers recommendations, or with applicable codes and standards, alert Architect in writing before installation.

C. If 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.

1.9 DEFINITIONS

A. Most terms used within the documents are industry standard. Certain words or phrases shall be understood to have specific meanings as follows:

1. Provide: Furnish and install completely connected up and in operable condition.
2. Furnish: Purchase and deliver to a specific location within the building or site.
3. Install: With respect to equipment furnished by others, install means to receive, unpack, move into position, mount and connect, including removal of packaging materials.
4. Conduit: Raceways of the metallic type which are not flexible.
5. Connect: To duct, pipe or wire up, including all branch ductwork, piping, and/or circuitry, control and disconnection devices so item is complete and ready for operation.
6. Subject to Mechanical Damage: Equipment, ductwork, piping 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.
7. General Contractor and Construction Manager are one in the same.

1.10 CONTRACT 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 ductwork and 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.

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, 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.

1.11 COORDINATION DRAWINGS

A. Coordination requirements specific to the Work of this Section include the following:

1. Before materials are purchased or work is begun, the respective Subcontractor shall prepare and submit to the Architect Coordination Drawings showing the size, elevation and location of his equipment, fixtures, ductwork, conduit, and piping lines relevant to the complete system. He shall ensure that these drawings are compatible and correctly annotated and cross-referenced at their interfaces.
2. 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 the Contract Drawings.
3. All coordination drawings shall be prepared in a large enough scale to accurately identify work of each trade and in addition to each sub-contractors systems, shall also show architectural floor plan, reflected ceiling plan, and structural framing with grid identification.
4. The coordination drawing shall be prepared in AutoCAD (version 2000 or later) and shall be started by the sheet metal sub-contractor and after applying all ductwork, the drawing shall be submitted for ductwork approval by the engineer. After approval, the drawing shall be circulated to the remaining sub-contractors for application of their work.
5. During coordination drawing preparation the sub-contractors shall meet periodically to discuss overall coordination of all sub systems, and shall adjust their systems accordingly. When all drawings are complete the general contractor shall submit to the architect and engineers for review.
6. Areas of conflict that cannot be resolved between the sub-contractor must be flagged on the drawings with adequate information to assist the architect and engineer in resolving noted issues. Re-designing and/or re-drawing coordination drawings due to conflicts shall not be an additional cost to the project.

B. Refer to Division 01 of these Contract Documents for general requirements and additional procedures relative to the preparation of Coordination Drawings.

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 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.

1.14 PHASING

A. The mechanical subcontractor shall construct the subject project in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

B. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the Architectural drawings.

1.15 NOTIFICATION OF RELATED TRADES

A. Notify all other trades responsible for installing chases, inserts, sleeves, anchors, louvers 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, and ducts for mechanical and electrical work as shown on drawings or required by layout of mechanical or electrical systems.

1.16 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.

1.17 CUTTING AND PATCHING

A. Penetrations through construction as required for the work of this Section:

1. Coring: Perform all coring for required work.
2. Notify Masonry Sub-Contractor of exact locations and sizes for openings required in masonry, to be executed under Section 042000 – UNIT MASONRY, utilizing lintels furnished per Section 055000 – METAL FABRICATIONS.
3. Cut openings in new and existing non-masonry construction where required for penetrations. All cutting shall conform to the requirements of Section 017329 – CUTTING AND PATCHING, and 024119 – DEMOLITION.
4. Refer to Section 024119 – DEMOLITION **f**or restrictions on all alterations to structural elements.

B. Patching at penetrations through construction as required for the Work of this Section:

1. Notify Masonry Sub-Contractor when HVAC work is complete at penetrations through masonry construction, and ready for patching under Section 042000 – UNIT MASONRY.
2. Notify appropriate Sub-Contractors when HVAC work is complete at penetrations through non-masonry construction, and ready for patching under Sections in Division 9 - FINISHES.

C. Drilling, coring, and cutting of new and existing structures (through walls, floors, ceiling) where the largest dimension does not exceed 12 in. shall be by this contractor.

D. Throughout the performance of the cutting and coring work, ensure that the structural integrity of the existing 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.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Patching of surfaces shall be by the trade responsible for the surface penetrated. Refer to Sections in DIVISION 9 – FINISHES for further requirements.

G. Refer to related architectural sections including Section 017329 for additional reference.

1.18 SUBMITTALS

A. General: Refer to Section 013300 – SUBMITTAL PROCEDURES for general requirements for submittal of product data, shop drawings and other materials for review by the Architect and their Consultants. The following paragraphs supplement the requirements of Section 013300.

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.

C. Submittal requirements specific to the Work of this Section include the following:
1. Meters and Gauges
2. Hangers and Attachments
3. Mechanical Identification
4. Mechanical Insulation

5. Condensate Drain Piping
6. Refrigeration Piping
7. Electric Terminal Heating Units
8. Rooftop Units
9. Ductless Cooling Unit Systems
10. VRF System
11. Metal Ductwork
12. Ductwork Accessories
13. Air Outlets and Inlets
14. Sound Attenuators and Sound Lining
15. Condensate Discharge Pumps
16. Automatic Temperature Controls
17. Testing, Adjusting, Balancing, and Commissioning

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.

1.19 SUBSTITUTIONS

A. Refer to, Section 011000 General Requirements paragraph 1.15 for requirements in requesting substitutions. The following paragraphs supplement the requirements of Section 011000 General Requirements paragraph 1.15.

B. If materials or equipment are substituted for basis of design 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 Architect/Engineer. Contractor shall be responsible for coordinating dimensional fit of equipment that varies from basis of design equipment. 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 from the basis of design equipment, 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.

1.20 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 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 of the three 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.

1.21 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.

1.22 DELIVERY, STORAGE AND HANDLING

A. Refer to Section General Conditions for delivery, storage, and handling of equipment. The following paragraphs supplement the requirements of Section 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 at the site, unless off-site storage is authorized in writing. 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.

1.23 RECORD DOCUMENTS

A. General: Refer to Section 011000 General Requirements paragraph 1.19, for general requirements for maintaining as-built drawings and submitting final reproducible record documents. The following paragraphs supplement the above.

B. Record Drawings for the Work of this Section shall include the following: Provide electronic AutoCAD 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.

1.24 OPERATION AND MAINTENANCE DATA

A. General: Refer to Division 01 for general requirements for submittal of operations and maintenance manuals, training of personnel and related closeout procedures. The following paragraphs supplement the requirements of Division 01.

B. In addition to the information required by Division 01 for maintenance data, Closeout procedures specific to the Work of this Section include the following:

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 start-up reports for all major HVAC systems and equipment, including but not limited to, all air handling equipment, ductless cooling unit systems, and fans.
6. Provide DVD recording of operation and maintenance training sessions and include as part of O & M Manual submittal. Provide indexed table of contents for DVD recording.
7. Cooperate with Commissioning agent as required to complete system and equipment start-up reports and testing.

1.25 WARRANTIES

A. The contractor shall provide a one year minimum warrantee on all product (unless otherwise stated in the product specification for a specific product) and labor for work under this section. Refer to general conditions for additional warranty requirements.

B. Refer to Section General Conditions and Division 01 for additional procedures and submittal requirements for warranties.

1.26 COMMISSIONING

A. GENERAL PROVISIONS
1. Commissioning Agent will be hired by the HVAC 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: Contract Closeout
   b. Section 230548: Vibration Control and Seismic Restraint

B. SYSTEMS TO BE COMMISSIONED
1. Systems to be commissioned shall be:
2. Variable Refrigerant Flow (VRF) System
3. Heat Pump Rooftop Units
4. Automatic Temperature Control System

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. Mechanical Design Team Representatives
   d. Mechanical Contractor Representatives
   e. Testing, Adjusting, and Balancing 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. Mechanical Contractor

a. The contractor shall be present as requested by the Commissioning Agent during the acceptance testing procedures of their respective systems and equipment.
b. The air and water balancing contractor shall provide all labor and equipment to test HVAC systems as requested by the Commissioning Agent.
c. The ATC contractor shall provide all labor and equipment to perform tests and verification procedures i.e.; overriding various control inputs or outputs, manipulating schedules, etc. as required by the Commissioning Agent.

2. General Contractor
   a. The General Contractor shall verify completeness of the building envelope, which may effect proper operation and control of HVAC 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.
   b. The Owner shall advise the Automatic Temperature Control Contractor and Commissioning Agent regarding building occupancy, usage, and time schedules.

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 dampers, valves, fans, terminal units, etc. Indication of device function from a DDC panel, 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, equilibrium upset, 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, adjusting, and balancing report 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 mechanical 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 HVAC work, or they may involve other systems, such as electrical 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 Static and Functional Review checklist:

1. ATC:

Automatic Temperature Control - Static Review Checklist

Project Name: **Date:**

Guidelines	Check Complete
Verify all wiring is plenum rated	☐
Verify all wiring teminations are looped at control device	☐
Verify all exposed wiring in occupied areas is run in wiremold or conduit	☐
Verify all wiring in mechanical spaces, boiler room etc. is in conduit	☐
Verify all wiring above ceiling shall follow routing of piping, is bundled and wire tied, supported adequately	☐
Verify all wiring installation proceedures are in accordace with Division 16000	☐
Verify perminant operator terminal installed and wired to emergency power	☐
Verify operator terminal recieves data link	☐
Verify installation of dial-up modem and telephone connection	☐
	☐

Notes:

Automatic Temperature Control - Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical connections complete and all data gathering panels	☐	☐	☐
	Individual circuits to each data gathering panel and labeled	☐	☐	☐
	Circuit feeding fixed "PC" is on emergency power	☐	☐	☐
	Data link is communicating between system and each computer	☐	☐	☐
	Electrical contractor sign off by:_____			
Inspection-Verification of Point List	Verify all points for each HVAC RTU (refer to control drawing)	☐	☐	☐
	Verify all points for VRF system (Refer to control drawings)	☐	☐	☐
		☐	☐	☐
Inspection-Verification of Sequence of Operation	Heat Pump RTU's	☐	☐	☐
	VRF system	☐	☐	☐
Inspection-Verification of Training	Owner has received 40 hours of training	☐	☐	☐

Notes:

2. VRF Indoor Unit:

VRF Indoor Evaporator- Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Disconnect installed	☐	☐	☐
	Overload heater sizes confirmed	☐	☐	☐
	Motor amps: Rated @ _____ Actual @_____	☐	☐	☐
	Rated @ _____ Actual @_____	☐	☐	☐
	Rated @ _____ Actual @_____	☐	☐	☐
	Motor voltage: Rated @ _____ Actual @_____	☐	☐	☐
	Motor "bumped" to confirm equipment rotation	☐	☐	☐
	Distribution and terminations labeled	☐	☐	☐
	Panel circuit label and/or bar coded	☐	☐	☐
	Electrical contractor sign off by:_____			
Inspection-Verification Automatic Controls	Points list completed	☐	☐	☐
	Interlock to automation system confirmed	☐	☐	☐
	Control Contractor sign off by:_____			
Inspection-Verification Equipment Installation	Vibration isolator installed	☐	☐	☐
	Equipment per contract documents/details/shop drawing	☐	☐	☐
	Seismic restraint installed	☐	☐	☐
	Noise level and/or vibration acceptable	☐	☐	☐
	Equipment labeled	☐	☐	☐
	Equipment has been cleaned inside and out	☐	☐	☐
	Piping contractor sign-off by:_____			
	Insulation contractor sign off by:_____			
Inspection-Verification Equipment Manufacturer	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Manufacturer sign off by:_____			
Inspection-Verification Pipe (HVAC) Distribution	Installation @ equipment completed	☐	☐	☐
	Connections per contract documents/details	☐	☐	☐
	System has been flushed clean	☐	☐	☐
	System is filled	☐	☐	☐
	Condensate drain piping installation completed	☐	☐	☐
	Piping contractor sign off by: _____	☐	☐	☐
		☐	☐	☐
		☐	☐	☐
Notes:				

VRF Indoor Unit - Static Review Checklist

Project Name:	**Date:**	
		Check Complete
Guidelines		
Confirm there is safe access to the equipment and around the equipment		☐
Confirm there is adequate access for maintenance service and equipment removal		☐
Have a system flow diagram when starting up the equipment		☐
Refer to Equipment Manufacturer's literature for additional data and requirements		☐
Check adequate condensate drain pan slope		☐
Check condensate pipe slope		☐
Check condensate pipe insulation		☐
Check condensate pipe termination		☐
Check indoor unit isolation valves installed		☐
Verify clean filter		☐
Verify clabinet not damaged or scratched		☐
Verify exterior and interior is clean		☐
Verify vibration isolation installed		☐
Verify seismic restraint installed		☐
Notes:		

3. VRF Outdoor Unit:

VRF Heat Recovery Condenser - Static Review Checklist

Project Name:	**Date:**

	Check Complete
Guidelines	
Confirm there is safe access to the equipment and around the equipment	☐
Confirm there is adequate access for maintenance service and equipment removal	☐
Have a system flow diagram when starting up the equipment	☐
Refer to Equipment Manufacturer's literature for additional data and requirements	☐
Check adequate condensate drain pan slope	☐
Verify clean filter	☐
Verify clabinet not damaged or scratched	☐
Verify exterior and interior is clean	☐
Verify vibration isolation installed	☐
Verify seismic restraint installed	☐

VRF Heat Recovery System- Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Disconnect installed	☐	☐	☐
	Overload heater sizes confirmed	☐	☐	☐
	Motor amps: Rated @ _____Actual @_____	☐	☐	☐
	Rated @ _____Actual @_____	☐	☐	☐
	Rated @ _____Actual @_____	☐	☐	☐
	Motor voltage: Rated @ _____Actual @_____	☐	☐	☐
	Motor "bumped" to confirm equipment rotation	☐	☐	☐
	Distribution and terminations labeled	☐	☐	☐
	Panel circuit label and/or bar coded	☐	☐	☐
	Electrical contractor sign off by:_____			
Inspection-Verification Automatic Controls	Points list completed	☐	☐	☐
	Interlock to automation system confirmed	☐	☐	☐
	Control Contractor sign off by:_____			
Inspection-Verification Equipment Installation	Vibration isolator installed	☐	☐	☐
	Equipment per contract documents/details/shop drawing	☐	☐	☐
	Seismic restraint installed	☐	☐	☐
	Noise level and/or vibration acceptable	☐	☐	☐
	Equipment labeled	☐	☐	☐
	Equipment has been cleaned inside and out	☐	☐	☐
	Piping contractor sign-off by:_____			
	Insulation contractor sign off by:_____			
Inspection-Verification Equipment Manufacturer	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Manufacturer sign off by:_____			
Inspection-Verification Pipe (HVAC) Distribution	Installation @ equipment completed	☐	☐	☐
	Connections per contract documents/details	☐	☐	☐
	System has been flushed clean	☐	☐	☐
	System is filled	☐	☐	☐
	Valves tagged	☐	☐	☐
	Piping contractor sign off by: _____			
		☐	☐	☐
Notes:				

4. Heat Pump Rooftop Air Handling Unit:

Heat Pump Rooftop Air Handling Unit - Static Review Checklist

Project Name:	**Date:**

	Check Complete
Guidelines	
Confirm there is safe access to the equipment and around the equipment	☐
Confirm there is adequate access for maintenance service and equipment removal	☐
Confirm there will not be short-circuiting of exhaust air into air intakes and/or other building openings	☐
Confirm there are no vents (plumbing, noxious exhaust etc.) within 25' of unit	☐
Confirm curb is insulated	☐
Confirm spring isolated seismic spring rail is installed	☐
Confirm economizer hood and controls are installed	☐
Confirm duct smoke detector and location	☐
Confirm installation of condensate drain with trap	☐
Have a system flow diagram when starting up the equipment	☐
Refer to Equipment Manufacturer's literature for additional data and requirements	☐
Confirm unit is fastened properly to structural steel and curb	☐

Notes:

Heat Pump Rooftop Air Handling Unit - Operational Performance Test

Project Name: **Date:**

		PASS	FAIL	N/A
Inspection-Verification Electrical	Electrical Connections Completed	☐	☐	☐
	Disconnect installed	☐	☐	☐
	Overload heater sizes confirmed	☐	☐	☐
	Motor amps: Rated @ _____ Actual @_____	☐	☐	☐
	Rated @ _____ Actual @_____	☐	☐	☐
	Rated @ _____ Actual @_____	☐	☐	☐
	Motor voltage: Rated @ _____ Actual @_____	☐	☐	☐
	Motor "bumped" to confirm equipment rotation	☐	☐	☐
	Distribution and terminations labeled	☐	☐	☐
	Panel circuit label	☐	☐	☐
	VFD installed and operating	☐	☐	☐
	Electrical contractor sign off by:_____			
Inspection-Verification Automatic Controls	Points list completed	☐	☐	☐
	Interlock to automation system confirmed	☐	☐	☐
	Interlock to fire alarm system confirmed	☐	☐	☐
	Outside air damper stroked for full open & close	☐	☐	☐
	Duct static pressure sensor installed and set	☐	☐	☐
	Smoke detector under control	☐	☐	☐
	Discharge air controller installed and set	☐	☐	☑
	Control contractor sign off by:_____			
Inspection-Verification Equipment Installation	Installation on spring isolated rail	☐	☐	☐
	Equipment per contract documents/details/shop drawing	☐	☐	☐
	Noise level and/or vibration acceptable	☐	☐	☐
	Equipment labeled	☐	☐	☐
	Equipment has been cleaned inside and out	☐	☐	☐
Inspection-Verification Equipment Manufacturer	Manufacturer's start-up sheet completed	☐	☐	☐
	Warranty sheet completed	☐	☐	☐
	Additional belts provided	☐	☐	☐
	Owner's training complete	☐	☐	☐
	Manufacturer sign off by:_____			
Inspection-Verification Pipe (HVAC) Distribution	Installation @ equipment completed	☐	☐	☐
	Connections per contract documents/details	☐	☐	☐
	Drain piping installed	☐	☐	☐
Inspection-Verification Sheet Metal Distribution	Installation @ equipment completed	☐	☐	☐
	Connections per contract documents/details	☐	☐	☐
	Turning vanes in first elbow	☐	☐	☐
	Ductwork sound lining installed	☐	☐	☐
	Sheet metal contractor sign off by:_____			
	Insulation contractor sign off by:_____			
Inspection-Verification Testing & Balancing	Final balancing @ equipment completed	☐	☐	☐
	Strainers cleaned and tagged	☐	☐	☐
	New filters installed	☐	☐	☐
	Air (CFM) is per design criteria	☐	☐	☐
	System static pressure is per design criteria	☐	☐	☐
	TAB contractor sign off by:_____			

Notes:

1.27 ENERGY REBATE PROGRAM

A. This project has been designed to incorporate equipment approved for energy rebate such as high efficiency motors, rooftop units and condensing units. Contractor 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. Contractor shall furnish equipment submittals, related equipment/system pricing data and fill out all required rebate application information, and forms to utility company.

1.28 TRADE RESPONSIBILITY FOR INTERCONNECTIONS MATRIX

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
Smoke Detectors (Area type)	26 00 00	26 00 00	26 00 00	230000 (ATC)	26 00 00	
Smoke Detectors (RTU mounted)	23 00 00	23 00 00	26 00 00	230000 (ATC)	26 00 00	
Smoke & Fire/Smoke Dampers	23 00 00	23 00 00	N/A	N/A	N/A	
Smoke & Fire/Smoke Damper Actuators	23 00 00	23 00 00	26 00 00 & 230000 (ATC)	230000 (ATC)	26 00 00	2
Fire Dampers	23 00 00	23 00 00	N/A	N/A	N/A	
Hydronic Control Valves	230000 (ATC)	23 00 00	N/A	230000 (ATC)	N/A	1
Hydronic Control Valve Actuator	230000 (ATC)	230000 (ATC)	230000 (ATC)	230000 (ATC)	N/A	1
Sheet Metal Damper	23 00 00	23 00 00	N/A	N/A	N/A	1
Sheet Metal Damper Actuators	230000 (ATC)	230000 (ATC)	230000 (ATC)	230000 (ATC)	N/A	1
Airflow Measuring Stations	230000 (ATC)	230000 (ATC)	N/A	230000 (ATC)	N/A	
DDC Panels	230000 (ATC)	230000 (ATC)	26 00 00 & 230000 (ATC)	230000 (ATC)	N/A	3
VFDs/ ECM at RTU FANS & ERW	230000	230000	26 00 00	230000 (ATC)	N/A	
Elevator Hoistway Vent Damper	23 00 00	23 00 00	N/A	N/A	N/A	
Elevator Hoistway Vent Damper Actuator	230000 (ATC)	230000 (ATC)	230000 (ATC)	230000 (ATC)	26 00 00	

Notes:

1. Division 23 00 00 and Division 230000 (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 00 to junction box locations shown on electrical drawings; Division 230000 (ATC) Contractor shall provide final power wiring from junction box to end device location.
3. Division 26 00 00 shall provide power at main DDC Panel. Division 230000 (ATC) shall provide power to all other DDC Panels.

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:

	HP	RPM	Efficiency
a.	1	1800	85.5 percent
b.	1.5	1800	86.5 percent
c.	2	1800	86.5 percent
d.	3	1800	89.5 percent
e.	5	1800	89.5 percent
f.	7.5	1800	91.0 percent
g.	10	1800	91.7 percent
h.	15	1800	93.0 percent
i.	20	1800	93.0 percent
j.	25	1800	93.6 percent
k.	30	1800	94.1 percent
l.	40	1800	94.1 percent
m.	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 Contractor 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 HANGERS & ATTACHMENTS (Refer to SECTION 230548 for Coordination)

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.

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.

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 outer 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.

2.3 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 ¾ 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 supply and return.
2. Refrigerant liquid and suction.
3. Condensate drain.

C. Valve Tags:

1. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in ¼ in. high letters and sequenced valve numbers ½ 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. Rooftop Units (RTU)
b. Electric Heating Units
c. Air Cooled Condensing Units (VRF and DCUc)
d. Ductless Cooling Unit Systems

F. Provide labels on supply, exhaust and return ductwork

1. Stencil on labels with appropriate paint for intended use. Label on sheet metal or insulation so it is visible.

2.4 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
3) Technology

4) 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. Insulate 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) Flexible Unicellular: (Refrigerant piping only) 1 in. thick.

C. Insulation on Piping Exposed to Weather: Protect outdoor insulation from weather by installing Redi-Klad Pipe Insulation or adding an outdoor protective finish aluminum jacketing installed to “standard” insulation as recommended by the manufacturer. 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
c. 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) Outdoor air intake ductwork between air entrance and air handling unit inlet.
2) HVAC supply ductwork between HVAC unit discharge and room terminal outlet.
3) Insulate neck and bells of supply diffusers.
4) HVAC return ductwork between room terminal inlet and HVAC unit inlet; except omit insulation on return ductwork located in return air ceiling plenums.
5) HVAC plenums and unit housing not pre-insulated at factory or lined.
6) Exhaust ductwork between in-line exhaust fan and point of exit in building.
7) Duct-mounted sound attenuators

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 outdoor ductwork in occupied areas shall be insulated with same thickness and material.
2) Flexible Glass Wool: 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 outside air ductwork shall be 3 in. rigid (R-12).

2. Equipment Insulation Materials:
3. Rigid Glass Wool Equipment Insulation (R-12): 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.
4. Flexible Glass Wool Equipment 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.
5. Flexible Unicellular Equipment Insulation: ASTM C 534, Type as required.
   TYPE I - TUBULAR.
   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.

F. Equipment Insulation Application and Thickness:

1. Application: Cold Equipment (Below Space Temperature):

a. Insulate the following cold equipment:

1) Drip pan under chilled equipment.

b. Insulate each item of equipment specified above with the following type and thickness of insulation:

1) Glass Wool: 2 in. thick for cold surfaces 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. Application: Hot Equipment

a. Insulate the following:

1) All Radiant Panels (laid on top of the panel) – Coordinate with unit manufacturer.

b. Insulate each item of equipment specified above with the following type and thickness of insulation:

1) Faced Glass Wool 1 in. thick for radiant panels.

2.5 HYDRONIC PIPING AND ACCESSORIES

A. Pipe and Tubing Materials

1. Copper Tubing: ASTM grade B 88, Type L hard drawn temper copper tubing.
2. Copper Tubing: ASMT grade B 88, Type K, annealed copper tubing.

B. Fittings

1. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B2.1.
2. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced.
3. Cast Bronze Flanges: ANSI B16.24, Class 150; raised ground face, bolt holes spot faced.
4. Solder Filler Metals: ASTM B 32, 50-50, Tin-Lead, for condenser water, and make-up water and drain piping.
5. Brazing Filler Metals: AWS A5.8.

   WARNING: Some filler metal contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

6. Gasket Material: Thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.
7. Flexible Connectors: Stainless steel bellows with woven flexible bronze wire reinforcing protective jacket; minimum 150 psig working pressure, maximum 250 degrees F. operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of ¾ in. misalignment.

C. Pipe Sleeves and Escutcheons

1. General: Provide schedule 40 black steel or 18 gauge 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.

2.6 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 in. and smaller: Copper tube; Type ACR, hard-drawn temper; wrought-copper, solder-joint fittings; brazed joints.

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: 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.
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 in. 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, 500 PSI working pressure.
8. Refrigerant Filter-Driers: Steel shell, ceramic fired desiccant core, solder connections, UL-listed, 500 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, 500 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.

G. Basic Vibration Control: Provide vibration control products as required in accordance with the following listing:

1. Isolation hangers.
2. Riser isolators.
3. Riser support isolators.
4. Flexible pipe connectors.

2.7 HEAT PUMP ROOFTOP UNITS

A. 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.

B. APPROVED MANUFACTURERS
1. Trane
2. Addison
3. Johnson Controls/ York
4. Or Equal

C. GENERAL UNIT DESCRIPTION
1. Unit(s) furnished and installed shall be packaged outdoor air unit (s) as scheduled on contract documents and these specifications. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, air filters, supply motors and unit controls
2. Before shipment, each unit(s) shall be leak tested, dehydrated, charged with refrigerant (R-410A) and compressor oil, and factory run tested for proper control operation.
3. The condenser coils must be aluminum fin, mechanically bonded to copper tubing.

4. Direct-drive, vertical discharge condenser fans must be provided with built-in thermal overload protection.
5. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
6. Unit(s) shall be dedicated downflow or dedicated, thru curb horizontal airflow as manufactured.
7. Wiring internal to the unit shall be colored and numbered for identification.

D. UNIT CASING

1. Cabinet: Zinc-coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 1000 hours in a salt spray test in compliance with ASTM B117. Unit shall have a 2 inch thick Antimicrobial Insulation. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. Structural members shall be a minimum of 16 gauge with access doors and removable panels of minimum 20 gauge.
2. Panels: 2” double-wall foamed panel construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed.
3. Insulation: 2” polyisocyanurate Foam metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness.
4. Cabinet construction shall provide access panels for all parts requiring service.
5. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
6. Panels: Water- and air-tight hinged panels with handles shall provide access to filters, heating section; optional ERV and power exhaust fan section, supply air fan section, evaporator coil section, and unit control section. Door hardware shall be oriented to allow the door swing to be reversed.
7. Latches with hold down hooks will be factory installed on hinged access doors.
8. Unit shall include a motor operated outside air damper, and air foil blades with rubber edge seals. Damper blades shall be designed to have no more than 4 cfm of leakage per sq. ft of damper area and shall exceed ASHRAE 90.1 requirements. Linkage shall be concealed out of airstream, within the damper frame to reduce pressure and noise. Damper assembly shall be controlled by a spring return two position actuator. Dampers shall not be sized for air velocities exceeding 2000 fpm.
9. Type 304 Stainless steel drain pan sloped in two directions to ensure positive drainage. Pan shall have a minimum depth of 2”. Seams exposed to standing water shall be welded liquid tight. Base of pan shall be insulated with 1” thick foam insulation.
10. Provide openings on side of unit for power & control connections.
11. Provide corrosion-inhibiting coatings for the unit condenser, hot gas reheat, and evaporator coils.
12. Coil Coating: Coil will have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas with no material bridging between fins. The coating process will ensure complete coil encapsulation and a uniform dry film thickness from 0.6 – 1.2 mills on all surface areas including fin edges and meet 5b rating cross hatched adhesion per ASTM B3359- 93.Corrosion durability will be confirmed through testing with no less than 5,000 hours salt spray resistance per ASTM B117-90 using scribed aluminum test school coupons. The coil coating will meet the following test standards:
    a. MIL-C-46168 Chemical Agent Resistance – DS2, HCL Gas
    b. CIDA-A-52474-A (GSA)
    c. MIL-STD810F, Method 509.4 (Sand and Dust)
    d. MIL-P-53084 (ME)-TACOM Approval
    e. MIL-DTL-12468 Decontamination Agent (STB)
    f. DPG (Dugway Proving Grounds) Soil & Water Exposure Tests

g. GM9540P-97 Accelerated Corrosion Test (120 cycles)
h. ASTMB117-G85 Modified Salt Spray (Fog) Testing-2,000 hours (tested by ARL for Lockheed Martin)
i. The unit(s) must comply per above - spray coatings not acceptable

13. The base of the unit shall have provisions for forklift and crane lifting

E. POWER WIRING

1. Field wiring access to be provided thru unit side into isolated enclosure with removable cover.
2. Power wiring to be single point connection.
3. Unit shall be factory wired to field wiring terminal block mounted in isolated enclosure.
4. Factory wired main power disconnect device, overcurrent and SCCA rated for total unit power connection.
5. Factory installed safety barrier shall isolate all high voltage components, mounted inside electrical compartment, to protect service personnel from incidental contact.
6. Factory wired Phase monitor shall be included as standard.
7. Factory to mount and wire 120 volt convenience outlet. Field wiring of convenience outlet not acceptable.

F. LOW VOLTAGE CONTROLS

1. Factory wired 24 volt control system complete with required transformers and fusing.
2. Main Control Module (MCM) shall prevent simultaneous operation of any modes and shall enable operation in Dehumidification, Cooling, Heating or Economizer mode based on programmed settings for:
3. Outdoor air conditions and discharge air temperature
4. MCM shall accept separate setpoints for Occupied and Unoccupied states.
5. MCM shall control based on dew point design settings for Dehumidification and Economizer modes, and sensible temperature settings for heating and cooling modes.
6. MCM shall have onboard clock and scheduling function for occupancy.
7. MCM shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
8. Factory installed and wired sensors shall monitor Outdoor Air (OA) temperature, humidity and evaporator leaving air temperature. Factory installed and wired sensors shall monitor the exhaust ERV leaving air temperature for defrost control.
9. Supply air sensor shall be furnished with unit. Installing contractor shall install remote mounted supply air sensor in supply air duct and field wire to the unit.
10. Fully modulating hot-gas reheat shall be enabled in dehumidification mode and cooling mode with modulation controlled by MCM to maintain supply air temperature.
11. System controls shall include anti-cycle timing and minimum compressor run/off-times.
12. Systems controls shall be digital, programmable type with access through portable computer connection. All setpoints, unit functions, and status shall be accessible via the portable computer.
13. Factory wired return air and supply air smoke detectors
14. All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.

G. FANS AND MOTORS

1. Indoor fans shall be high efficiency backward curved impeller.
2. The indoor fan motor shall be an electronic commutated motor with integrated power electronics for variable motor speed.
3. All fan motors shall be premium efficiency ODP and meet the U.S. Energy Policy Act of 2005/10 (EPACT).
4. All fan motors shall be permanently lubricated and have internal thermal overload protection.

5. Outdoor fan motors shall be an electronic commutated with integrated power electronics for variable motor speed, statically and dynamically balanced, draw through in the vertical discharge position.
6. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

H. ELECTRIC PRE-HEAT SECTION
1. Pre-heat is supplied using Electric Resistance heaters. Heaters shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment. Heating elements shall be finned tubular. All elements are to consist of 80% nickel, 20% chromium, Type A resistance wire, precisely centered in a stainless steel tube and filled with granular magnesium oxide. The entire assembly is to be compacted to maximize both the heat transfer and dielectric properties of the magnesium oxide. After compaction, the tube must be a minimum of 0.475" O.D. to provide sufficient insulation for operation up to 600 volts. A corrugated stainless steel fin is to be wrapped around the tube to increase its heat transfer surface. Both straight and U-bent elements are to be furnished with mounting flanges, making them individually removable from the terminal box. Element support brackets are not to be spaced more than 36" apart. Finned tubular heaters shall be furnished with an airflow switch, contactors, fuses (if over 48 amps), control circuit transformer (with primary fusing on Class I circuits as required), built-in, snap acting, door interlock disconnect switch, and triple overtemperature protection. Disk and linear type automatic reset thermal cutouts for primary overtemperature protection and a linear type, pilot duty manual reset thermal cutout with backup contactors (as required) for secondary protection. Heat limiters or other fusible overtemperature devices are not acceptable. Heater frames and terminal boxes shall be corrosion resistant steel. Unless otherwise indicated, the terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover. Control will be ON/OFF. Unit shall be suitable for use with Electric Resistance Heat.

I. MODULATING ELECTRIC HEATING SECTION
1. The unit(s) shall have fully modulating, SCR controlled, electric heat. The primary heating section will include finned tubular heating elements, automatic and manual cut-outs, low voltage controls, air proving switch, maximum 48 amps per circuit and fusing for heaters over 48 amps.
2. Heater shall be internal to unit cabinet and downstream of the evaporator fan.
3. Heater shall be UL or CSA listed and approved and provide single point power connection.

J. EVAPORATOR CONDENSOR AND REHEAT COILS
1. Evaporator and hot gas reheat coils shall be constructed of copper tubes mechanically bonded to a configured aluminum plate fin.
2. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil, reheat coil and condenser coil shall be leak tested to 500 psig and pressure tested to 500 psig.
3. The condenser coil shall have a fin designed for ease of cleaning.
4. Evaporator coil shall have four interlaced rows for superior sensible and latent cooling with a maximum of 12 fpi.
5. Reheat coil shall be fully integrated into the supply air and fan system and capable of delivering design supply air temperature.
6. To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated a minimum of six inches.
7. Condenser coil shall be provided with factory installed hail guards.
8. Unit shall be equipped with an adjustable 6” filter rack upstream of the evaporator to match the filter requirements specified in the Air Filtration section

K. CONDENSER SECTION
1. Outdoor Fans: vertical discharge, direct drive fans constructed of glass reinforced polypropylene blades. Fans shall be low-noise and corrosion resistant. Other fan construction is not acceptable.
2. Fans shall be statically balanced.

L. REFRIGERANT CAPACITY CONTROL
1. Capacity control for units equipped with digital scroll compressors, or variable speed compressors, shall be accomplished through a 0-10V signal by the MCM to the compressor controls.

M. REFRIGERATION SYSTEM
1. Compressor(s): All units shall have direct-drive, hermetic, scroll type compressors.
2. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
3. Internal overloads shall be provided with the scroll compressors.
4. Each compressor shall have a crankcase heater to minimize the amount of liquid refrigerant present in the oil sump during off cycles.
5. Each compressor shall be mounted on rubber vibration isolators, to reduce the transmission of noise.
6. Provide each unit with hermetically sealed refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, liquid line charging port, discharge, suction and liquid line pressure ports, sight glass, thermal expansion valve, 4-way reversing valve, suction line accumulator, and charge compensator..
7. Provide each circuit with automatic reset high and low pressure switches for safety control.

N. POWER EXHAUST/RETURN SECTION
1. Provide, a factory installed power exhaust assembly that shall be designed to ventilate return air to atmosphere.
2. Fan wheel shall be direct drive plenum fan, factory installed and wired to on-board Variable Frequency Drive Other fan construction is not acceptable
3. Fan mount to be fixed.
4. Exhaust to ventilate through automatic louver located on both sides of unit cabinet.

O. OUTDOOR AIR SECTION ENERGY RECOVERY (ERV)
1. The rotor media shall be made of aluminum, formed into a honeycomb structure to minimize pressure loss and avoid plugging. Paper, plastic or fibrous media are not acceptable. The rotor media must be coated to resist corrosion. All surfaces must be coated with a non-migrating desiccant layer to insure that adequate latent capacity is provided. The desiccant coating must be firmly bonded to the aluminum surface and will not be dislodged when challenged with high velocity air up to 5000 feet per minute. Products that loose desiccant when served with high velocity air are not acceptable. The cassette must be a slide out design for serviceability. The media shall be cleanable with low temperature steam, hot water or light detergent without degrading the latent recovery.
2. Sensible and latent recovery efficiencies must be clearly documented through a testing program conducted in accordance with ASHRAE Standard 84 and AHRI 1060. The testing must have been conducted by a qualified independent organization. The performance test reports must be provided for engineering review as part of the submittals for this project.
3. The rotor design shall ensure laminar airflow to minimize parasitic pressure loss and to optimize the operating efficiency of the system fans. The pressure loss across the media shall be no greater than the scheduled pressure loss values. The energy wheel shall operate effectively up to 180 degrees F.
4. The rotor media shall be permanent, with an anticipated life of 20 years. It must be tested in accordance with ASTM Standard E-84 and provide smoke and flame spread ratings of less than 25 and 50 as required by NFPA 90A and UL 1995. A copy of the ASTM E-84

test report confirming the method of test and results shall be provided with the submittal. Heat recovery wheels incorporating “throw-away” media and tested to UL900 for Class 2 filters are not acceptable.

5. The wheel manufacturer must have been producing energy recovery wheels for a minimum of ten years.
6. The rotor shall be supplied with perimeter brush seals and face contact seals to minimize air leakage and wheel bypass.
7. The rotor media shall be supported by a structural aluminum hub and aluminum reinforcing spoke system. The rotor bearings must be greaseable and provide L10 life in excess of 20 years.
8. The cassette framework shall be made of galvanized steel to prevent corrosion.
9. The rotor must be driven by long-life polyurethane/polyester composite link belt system. The rotor/cassette shall be designed so that belt can be removed or serviced without the removal of the bearing. A 3 phase A/C gear motor shall be utilized to accommodate variable speed applications.

P. BUILDING MANAGEMENT SYSTEM

1. Interface control module to BACnet Energy Management System to be furnished and mounted by rooftop unit manufacturer. Through this interface module, all Energy Management functions (specified in Energy Management Section) shall be performed. See Building Automation and Automatic Temperature Control System Specifications. The interface module with necessary controls and sensors shall all be factory mounted (not field mounted). The only field connection to Energy Management System shall be two wire communication link.
2. Control Functions: Occupied/unoccupied mode, conditioning mode set points, discharge air set point adjustment, and alarm shutdown
3. Diagnostic Functions: Include supply fan status, filter status, outside air damper status,
4. Provide capabilities for Boolean Processing and trend logs as well as "templated" reports and logs.

Q. ROOF CURB

1. Curb shall be minimum 30” High plenum-type for horizontal 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.

R. SEQUENCE OF OPERATIONS

1. Microprocessor controller - Each OAU shall be controlled by a stand-alone microprocessor based controller with resident control logic. The controller will interface with the BAS (BACNET or Lonworks) and the inputs and outputs in the points list to accomplish the following temperature control and energy conservation strategies.
2. Occupied Discharge Air Control Mode - All unit functions will be enabled for normal heating and cooling operation to maintain supply air heating /cooling discharge air setpoints. Unit defaults to default temperature setpoints in the unit microprocessor when communication with BAS is lost.
3. Low Ambient Compressor Lockout - Compressor operation shall be disabled below a user defined outdoor air temperature.
4. Unit status report - For each OAU unit, the BAS shall provide an operating status summary of all sensed values (zone temperature, discharge temperature, etc.) setpoints and modes.
5. Supply Air Tempering - When the unit is in the heat mode, but not actively heating, outdoor air heat set point will continue heat operation to maintain a minimum discharge air heating temperature setpoint and prevent heater cycling.

S. WARRANTY

1. Provide five year parts and labor warranty from date of shipment.

2. Provide twenty-five year heat exchanger limited warranty from date of shipment.

2.8 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. Refer to HVAC control drawings for control requirements.

B. Refer to Division 23 automatic temperature control for control sequence.

C. DIRECT DRIVE PREMIUM CEILING MOUNTED CENTRIFUGAL EXHAUST FANS - GREENHECK MODEL SP-A
1. General Description:
   a. Base fan performance at standard conditions (density 0.075 Lb/ft3)
   b. Ceiling mounted applications
   c. Performance capabilities up to 1,600 cubic feet per minute (cfm) and static pressure to 0.75 inches of water gauge
   d. Fans are available in nineteen sizes (50 - 1550 unit sizes)
   e. Maximum operating temperature is 130 Fahrenheit (54.4 Celsius)
   f. Sound levels as low as 0.7 AMCA sonesSound levels as low as <0.3 AMCA sones
   g. UL/cUL listed for above bathtub exhaust
   h. Fans are UL/cUL listed 507 - Electric Fans
   i. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number
2. Wheel:
   a. Forward curved centrifugal wheel
   b. Constructed of galvanized steel or calcium carbonate filled polypropylene
   c. Statically and dynamically balanced in accordance to AMCA Standard 204-05
3. Motors:
   a. AC Induction Motor
      1) Motor enclosures: Totally enclosed air over: (TEAO)- designed to be used solely in the airstream, constructed with a dust tight cover and a aerodynamic body which replies upon the strong airflow of the fan to cool the motor, not suitable for hazardous environments.
      2) Motors shall be permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase.
      3) Motor shall be mounted on vibration isolators and be accessible for maintenance
      4) Thermal overload Protection
4. Housing:
   a. Constructed of heavy gauge galvanized steel
   b. Interior shall be lined with 0.5 inches of acoustical insulation
   c. Profile as low as 10 1/2 inches
5. Spring Loaded Aluminum Backdraft Damper:
   a. Prevents air from entering back into the building when fan is off
   b. Eliminates rattling or unwanted backdrafts
6. Outlet:
   a. Type of outlet: Round
   b. Field rotatable from horizontal to vertical discharge
   c. Shall include an aluminum backdraft damper
7. Grille:
   a. Type: Designer - Calcium-carbonate, Factory Standard
   b. Constructed of aluminum non-yellowing, aluminum shall be factory standard

8. External Electrical Accessories:
    a. Eliminates removing the motor pack which saves time on installation

9. Mounting Brackets:
    a. Fully adjustable for multiple installation conditions

D. Penthouse Elevator Ventilator
1. Type: Penthouse style gravity ventilator with louvers on three sides and breakable glass on the remaining side. Vent shall be sized to comply with the Massachusetts Elevator Code.
2. Smoke Damper: Provide a sheetmetal damper rated for smoke duty in the throat of the unit. The damper shall be rated for leakage Class 1. The actuator shall be 120V, fail open with open-closed indicator.
3. Louvers: Louvers shall be heavy gauge extruded stationary louvers constructed of 6063-T5 aluminum of 0.081 in. thickness. Louver shall be 4 in. deep. Louvers shall have a removable bird screen panel mounted on the inside face of the louver. The aluminum bird screen shall be ¾ in. flattened, expanded mesh of 0.051 in. thickness.
4. Glass: Glass panel shall be 0.125 in. thick annealed clear breakable glass.
5. Hood: Hood shall be 38 in. x 38 in. x 18 in. high. Hood shall be constructed of 0.100 thick formed aluminum insulated with 0.5 in. duct liner with an anti-microbial coating.
6. Curb: Curb shall be constructed of 12 gauge cold rolled steel of welded construction with a 4 in. mounting flange.
7. Finish: Penthouse vent and curb to be provided with a two coat 70 percent Kynar/Hylar finish in color selected by Architect. Dry film thickness shall be 1.2 mil. Provide ten year finish warranty. Submit color selection chart to Architect as part of submittal package.
8. Manufacturer: Subject to compliance with specifications herewithin, acceptable manufacturers include: Greenheck Model PEV-400 or equal.

2.9 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 scheduled 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. Chromalox Div.; Emerson Electric Co.
    b. Federal Pacific Electric Co.
    c. Gould Inc.
    d. Markel Nuton Div.; Scoville Inc.
    e. TPI Corporation.
    f. Qmark
    g. Or Equal.

B. Electric Radiant Wall Panels

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. Runtal
    b. Chromalox Div.; Emerson Electric Co.
    c. Federal Pacific Electric Co.
    d. Gould Inc.
    e. Markel Nuton Div.; Scoville Inc.
    f. TPI Corporation.
    g. Or Equal.

C. Air Curtain
1. Construction: Provide factory-assembled units of sufficient structural strength to be supported from ends without intermediate support. Ship units completely assembled.
2. Cabinet:
    a. Material and Finish: Stainless steel cabinet with stainless steel riveted construction.
    b. Dimensions: Not to exceed 8.5 in (21.6 cm) high by 13.5 in (34.3 cm) deep.
    c. Mounting: Provide for wall mounting.
    d. Service Access: Removable screen and removable bottom access panel.
3. Motors: 1/5-HP, 1680 rpm, single phase, 2-speed, ODP, direct drive, resilient mounted, continuous duty, with internal thermal-overload protection and permanently lubricated sealed ball bearings.
4. Fans: Balanced forward curved cross flow, tangential type, made of aluminum with flexible hubs and mounted in matched fan scrolls constructed of material used in constructing cabinet.
5. Discharge Nozzles:
    a. Provide uniform velocity across width of air curtain.
    b. Aperture: 2.375 in (6 cm) slot by width of air curtain.
6. Vanes: 1.5 in (3.8 cm) minimum height; constructed of airfoil-shaped aluminum extrusions; adjustable plus or minus 20 degrees to deflect airflow.
7. Inlet:
    a. Location: Front.
    b. Screen: Perforated pattern constructed of the same material and finish used for the cabinet.
8. Air Inlet Filter: Flat faced fire-rated re-cleanable aluminum with integral filter brackets.
9. HEATING ELEMENTS
    a. Electric Heating Coil: UL-approved, factory-mounted, factory-wired, thermally-protected, in galvanized steel frame.
        1) Helical coil with point suspended elements, [single] [three] phase circuit.
        2) Thermal Cutout: Locks out electric heater when prolonged abnormal over-temperature conditions exist.
10. CONTROLS
    a. Switching:
        1) Manual Switch: Factory installed “Fan-Off-Fan & Heat” and “High-Low” switches
    b. Deluxe Automation Control Package:
        1) 24 Volt Control: NEMA 4 plunger style door switch and factory-installed time delay.

2) Unit shall allow for external control by Remote controller by others or Building Management system

11. MOUNTING ACCESSORIES
    a. Provide brackets and other mounting accessories as required to permit installation and proper functioning of air curtain to meet project conditions of use.
        1) Z-style Wall Bracket: 4.5 in (11.4 cm) to 7 in (17.8 cm) adjustable depth mounting bracket from stainless steel
12. WARRANTY
    a. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air curtains that fail in materials or workmanship within specified warranty period.
    b. Two-year limited warranty for heated units.
13. QUALITY ASSURANCE
    a. Manufacturers: Firms regularly engaged in manufacture of air curtains of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide air curtains produced by a manufacturer listed in this section.
    b. Source Limitations: Obtain each type of air curtain through one (1) source from a single manufacturer.
    c. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    d. Certification:
        1) Unheated, electric, steam and hot water heated units to be UL Listed in the United States and Canada.

14. Manufacturers: Subject to compliance with requirements, provide radiant cove heater of one if the following:

    a. Berner International
    b. Qmark
    c. Chromalox Div.; Emerson Electric Co.
    d. Federal Pacific Electric Co.
    e. Gould Inc.
    f. Markel Nuton Div.; Scoville Inc.
    g. TPI Corporation.
    h. Or Equal.

2.10 VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

A. SYSTEM DESCRIPTION R2-SERIES (SIMULTANEOUS HEAT/COOL)
1. Per the equipment schedule, the variable capacity, heat pump heat recovery air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Daikin, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufacturer’s product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.

3. Simultaneous heating/cooling (heat recovery) systems shall consist of an outdoor unit, BC (Branch Circuit) Controller (or comparable branch devices), multiple indoor units, and an integral DDC (Direct Digital Controls) system. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes.
4. No additional branch circuit controllers (or comparable branch devices) than shown on the drawings/schedule may be connected to any one outdoor unit. Contractors proposing alternate systems requiring more branch devices than those included as the basis of design are responsible for additional piping & electrical costs and are required to identify additional costs & installation time required of other trades with their bid.

B. QUALITY ASSURANCE
1. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
3. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
4. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
5. System start-up supervision shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in system configuration and operation. The representative shall provide proof of manufacturer certification indicating successful completion within no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals.
6. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
7. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
8. Manufacturer shall have a minimum of fifteen (15) years continuous experience providing VRF systems in the U.S. market.
9. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
10. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

C. R2-SERIES HIGH EFFICIENCY (HEAT RECOVERY), AIR COOLED OUTDOOR UNITS
1. General:
   a. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

b. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.
c. Outdoor unit shall have a sound rating no higher than 65 dB(A) individually or 68 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 55 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
d. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
e. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
f. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.
g. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
h. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
i. The outdoor unit shall be capable of operating in heating mode down to -25F ambient temperatures or cooling mode down to 23F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
j. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.
k. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.
l. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.
m. In reverse defrost all refrigerant shall be bypassed in the main branch controller and shall not be sent out to the indoor units, systems that flow refrigerant through indoor units during reverse defrost shall not be allowed.
n. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.

o. VRF four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

2. Unit Cabinet:
   a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
   b. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
   c. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.
3. Fan:
   a. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG. external static pressure, but capable of normal operation with a maximum of 0.32 in. WG. external static pressure via dipswitch.
   b. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
   c. All fans shall be provided with a raised guard to prevent contact with moving parts.
4. Refrigerant and Refrigerant Piping:
   a. R410A refrigerant shall be required for systems.
   b. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
   c. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
   d. All refrigerant piping must be insulated with ½” closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
   e. Refrigerant line sizing shall be in accordance with manufacturer specifications. Future changes to indoor unit styles or sizes must be possible without resizing/replacing refrigerant piping to any other branch devices or indoor units.
5. Coil:
   a. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil
   b. Outdoor Coil shall be elevated at least 12” from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer’s in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12” of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
   c. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
   d. The coil shall be protected with an integral metal guard.
   e. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
   f. Unit shall have prewired plugs for optional panel heaters when operating below ambient conditions of 1F to prevent any residual ice buildup from defrost.

g. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

6. Compressor:
   a. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.
   b. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
   c. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.
   d. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.
   e. The compressor shall be equipped with an internal thermal overload.
   f. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
   g. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.
7. Controls:
   a. Outdoor unit shall include Variable Evaporator Temperature or comparable method of varying system evaporator (refrigerant) temperature in order to reduce compression ratio and power consumption during light load or mild ambient temperatures. Multiple evaporator refrigerant temperature settings shall be required in order to optimize efficiency within required system-specific performance and installation constraints. System shall reduce compression ratio only when/if all indoor units are within 1.8F of set point; reducing compression ratio based solely on ambient temperature risks discomfort and is not allowed. Variable Evaporator Temperature or comparable method shall incorporate override or disable capability based on external signal to allow for space humidity control or load demand. The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
   b. Each outdoor unit module shall have the capability of 4 levels of demand control based on external input.
8. Electrical:
   a. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.
   b. The outdoor unit shall be controlled by integral microprocessors.
   c. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

D. BRANCH CIRCUIT (BC) CONTROLLERS AS REQUIRED FOR SIMULTANEOUS HEAT/COOL SYSTEMS
   1. General
      a. BC (Branch Circuit) Controllers (or comparable branch devices) shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices which do not include controlled refrigerant subcooling risk bubbles in liquid supplied to indoor unit LEVs and are not allowed.
      b. BC Controllers (or comparable branch devices) shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish and be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. BC Controllers (or comparable branch devices) shall be suitable for use in plenums in accordance with UL1995 ed 4.
   2. BC Unit Cabinet:
      a. The casing shall be fabricated of galvanized steel.
      b. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
      c. The unit shall house two tube-in-tube heat exchangers.
   3. Refrigerant Piping (specifications in addition to those for outdoor unit):
      a. All refrigerant pipe connections shall be brazed.
      b. Future changes to indoor unit quantities or sizes served by BC Controller or comparable branch device must be possible with no piping changes except between the branch device and indoor unit(s) changing. Systems which might require future piping changes between branch device and outdoor unit—if changes to indoor unit quantities or sizes are made—are not considered equal and are not allowed.
   4. Refrigerant valves:
      a. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
   5. Future Use Branch:
      a. Each VRF system shall include at least one (1) unused branch or branch device for future use. Future-use branches or branch devices shall be fully installed & wired in central location with capped service shutoff valve & service port.
   6. Condensate Management:
      a. BC Controller (or comparable branch device) must have integral resin drain pan or insulate refrigeration components with removable insulation that allows easy access for future service needs. Cabinets filled with solid foam insulation do not allow for future service and are not allowed.
   7. Electrical:
      a. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
      b. The BC Controller shall be controlled by integral microprocessors
      c. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total.

E. WALL MOUNTED INDOOR UNIT

1. General:
   a. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
2. Unit Cabinet:
   a. All casings, regardless of model size, shall have the same white finish
   b. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.
   c. There shall be a separate back plate which secures the unit firmly to the wall.
3. Fan:
   a. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.
   b. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
   c. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
4. Filter:
   a. Return air shall be filtered by means of an easily removable, washable filter.

5. Coil:
   a. Basis of design indoor units include factory-installed LEV/EEV. Alternative brands which require field-installed, accessory LEV or EEV kits are permissible only with written Engineer and Architect approval for the location of kits being submitted two weeks prior to bid date. EEV kits mounted in cavities inside fire-rated interior walls shall be mounted inside three hour fire rated enclosures with access panels supplied by the manufacturer. Enclosure type and placement require prior approval.
   b. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
   c. The coils shall be pressure tested at the factory.
6. Electrical:
   a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
   b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)
7. Controls:
   a. The unit shall include an IR receiver for wireless remote control flexibility
   b. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
   c. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
   d. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
   e. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

F. CONTROL OVERVIEW
1. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
2. Furnish energy conservation features as follows:
   a. optimal start
   b. request-based logic
   c. demand level adjustment of overall system capacity
3. System shall be capable of email generation for remote alarm annunciation.

G. ELECTRICAL CHARACTERISTICS
1. General:
   a. Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.
2. Wiring:
   a. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
   b. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.
3. Wiring type:
   a. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.
   b. Network wiring shall be CAT-6 with RJ-45 connection.

H. CITY MULTI CONTROLS NETWORK
1. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces.

I. CMCN: REMOTE CONTROLLERS
1. Simple MA Remote Controller (PAC-YT53CRAU):
   a. The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).
   b. The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers (PAR-FL32MA-E / PAR-FA32MA-E) or with other Backlit Simple MA Remote Controllers (PAC-YT53CRAU), with up to two remote controllers per group.

J. CENTRALIZED CONTROLLER (WEB-ENABLED)

1. AE-200 Centralized Controller:
   a. The AE-200A Centralized Controller shall be BACnet Compatible and capable of controlling a maximum of two hundred (200) indoor units across multiple CITY MULTI outdoor units with the use of three (3) AE-50A expansion controllers. The AE-200A Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The AE-200A Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the AE-200A Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the AE-200 Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the AE-200A provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the AE-200A Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.
   b. All AE-200A Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three AE-50A expansion controllers for display of up to two hundred (200) indoor units on the main AE-200A interface.
   c. The AE-200A Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.
   d. Standard software functions shall be available so that the building manager can securely log into each AE-200A via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Energy shall be available but are not included. The Energy Apportionment function shall require TG-2000 Integrated System software in conjunction with the Centralized Controllers.
2. AE-50A Expansion Controller:
   a. The AE-50A Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the AE-200A Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface of the AE-200A. Up to three (3) AE-50A expansion controllers can be connected to the AE-200A via a local IP network (and their IP addresses assigned on the AE-200A) to the AE-200A to allow for up to two hundred (200) indoor units to be monitored and controlled from the AE-200A interface.
   b. The AE-50A expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the AE-200A and configured to display their units on the main controller, the individual indoor units connected to the AE-50A can still be monitored and controlled from the interface of the AE-50. The last command entered will take precedence, whether at the wall controller, the AE-50A or the AE-200A Centralized Controller.

K. CMCN REMOTE CONTROLLERS: SYSTEM INTEGRATION
1. The CMCN shall be capable of supporting integration with a BACnet Building Management Systems (BMS).

2.11 METAL DUCTWORK

A. Ductwork Materials:

1. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including piping, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.
2. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lock forming quality, with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.
3. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A 167; Type 302, 304, or 316; with No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation. For exposed stainless steel ductwork, provide matching stainless steel support materials.
4. Aluminum Sheet: In Locker Room areas and dishwasher exhaust provide aluminum sheet complying with ASTM B 209, Alloy 3003, Temper H14. Dishwasher exhaust shall have all seams soldered vapor tight. For aluminum ductwork, provide aluminum support materials.

B. Miscellaneous Ductwork Materials:

1. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
2. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.
3. Duct Liner: Refer to “Acoustic Duct Lining Section”.
4. Duct Liner Adhesive: Comply with ASTM C 916 "Specification for Adhesives for Duct Thermal Insulation".
5. Duct Liner Fasteners: Comply with SMACNA HVAC Duct construction Standards, Article S2.11.
6. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation details, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
7. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
8. Flexible Ducts: Corrugated aluminum complying with UL 181.

a. Where installed in unconditioned spaces other than return air plenums, provide 1 1/2 in. (R-5) thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

C. Fabrication:

1. Shop fabricated ductwork in 4 ft., 8 ft., 10 ft. or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassembled work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
2. Shop fabricated ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards".

3. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1-1/2 times associated duct width; or squared metered elbows with double thickness turning vanes. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
4. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to section "Ductwork Accessories" for accessory requirements.
5. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

D. Factory-Fabricated Low Pressure Round And Oval Ductwork:

1. General: Provide factory-fabricated duct and fittings.
2. Material: Material type shall be as indicated or, galvanized sheet steel complying with ASTM A 527, lock forming quality, with ASTM A 525, G90 zinc coating, mill phosphatized.
3. Gauge: 28-gauge minimum for round and oval ducts and fittings, 4 in. through 24 in. diameter.
4. Seams: All seams shall be spiral lockseams.
5. Elbows: One piece construction for 90 degrees and 45 degree elbows 14 in. and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.
6. Divided flow Fittings: 90 degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.
7. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following:

    a. Semco Mfg., Inc.
    b. United Sheet Metal Div., United McGill Corp.
    c. Or equal

2.12 DUCTWORK ACCESSORIES

A. Dampers:

1. Low Pressure Manual Dampers: Provide dampers of single blade type or multi-blade 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 in. static pressure. Construct blades of 16-ga. aluminum; provide 1/2 in. diameter ball bearings, 1/2 in. diameter steel axles spaced on 9 in. centers. Construct from 2 in. x 1/2 in. x 1/8 in. steel channel for face areas 25 sq. ft. and under: 4 in. x 1-1/4 in. 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 out of air stream type damper in open position and with positive lock in closed position with stainless steel heat treated type 301 closure spring, and with the following additional features:

   a. Damper Blade Assembly: Curtain type.
   b. Blade Material: Steel, match casing.
   c. Blade Material: Stainless steel.

2. Combination Fire/Smoke Dampers: Provide fire/smoke dampers, of types and sizes indicated. Construct casing of 11-ga. galvanized steel with bonded red acrylic enamel finish. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated.. Provide stainless steel spring loaded leakage seals in sides of casing, and 36 in. long wire leads for connecting smoke link to smoke detector, and the following construction features:

   a. Unit Assembly: Fusible link and actuator mounted within airstream for accessibility through damper sleeve.
   b. Damper Blade Assembly: Multi-blade type.
   c. Blade Material: 16 GA galv. steel.
   d. Damper must be rated for mounting vertically (with blades running horizontal) or horizontally and be UL 555S rated for leakage and airflow in either direction through the damper. Each damper shall be supplied with a 165°F RRL.

3. Motor-Driven Fire/Smoke Dampers: Provide motor-driven fire/smoke dampers in types and sizes indicated, 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 in. long wire leads for connecting to smoke detector, and with the following construction features:

   a. Unit Assembly: Motor mounted inside air stream.

   b. Damper must be rated for mounting vertically (with blades running horizontal) or horizontally and be UL 555S rated for leakage and airflow in either direction through the damper. Each damper shall be supplied with a 165°F RRL.

4. Manufacturer: Subject to compliance with requirements, provide fire and smoke 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. Greenheck model FSD-211
   i. Or Equal.

C. Turning Vanes:

1. Manufactured Turning Vanes: Provide double thickness airfoil turning vanes constructed of 1-1/2 in. wide curved blades set at ¾ in. o.c., supported with bars perpendicular to blades set at 2 in. 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. Southern, 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 in.. 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. Ventfabrics, 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. All access doors to be a minimum of 12 in.x12 in. and to be gasketed and installed air tight. Provide one 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 in. 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.

2.13 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 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 and C1104, 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.

2.14 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 gauge 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 based upon application (or 16-gauge for outer casing and 22-gauge for inner casing).

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. Industrial Acoustics Co.
4. Price
5. Or Equal.

2.15 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 in. 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. Plaque diffuser shall be one piece seamless back cone with round inlet color and inner removable plaque assembly.

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
b. Metalaire – “5000 IV”
c. Price
d. 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. Agitair (Air Devices)
b. Metalaire
c. Price
d. 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 in. x 1/2 in. "Egg-Crate" with one in. 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. Agitair (Air Devices)
    b. Metalaire
    c. Price
    d. Or Equal.

D. Linear Diffusers

1. Linear slot diffusers shall be furnished and installed as indicated on the drawings.
2. Provide shop drawings accompanied by itemized list indicating units' location and appropriate product submittal drawings provided by the manufacturer.
3. Exact dimensions of walls and ceiling are as per the architectural drawings. Install diffusers so they fit properly in the ceiling system with suspension wire (48 in. o/c MAX.) and/or attachment plates — as required.
4. Coordinate installation with General Contractor and other sub-contractors.
5. The linear slot diffuser shall utilize heavy wall extruded aluminum air deflector frames. These frames shall be designed to accommodate notched compressible space bars, complete with integral hanger, spaced approximately 24 in. on center. The steel air pattern controllers are fully adjustable and can be moved from side to side to create various air pattern configurations. These dual pattern controllers shall be fully adjustable to allow shut-off without adding any blank-off devices. The spacer bars and pattern controllers shall be removable for on-site modification and trimming.
6. The Linear slot diffuser shall be complete with factory end conditions as shown or indicated.
7. Supply air engineered plenums shall be provided and manufactured of heavy gauge wipe coat steel. These units shall be insulated with a side inlet collar.
8. When engineered plenum end caps cannot positioned directly over the linear spacer bar due to field conditions, install MB Blank-Off from plenum end cap to next spacer bar.

9. MB Blank-Off shall be manufactured of heavy gauge steel painted black.
10. Linear Bar Grilles: Furnish and install extruded bar supply/return grilles of the sizes and mounting types indicated on the plans and outlet schedule.

    a. Construction: Grilles shall have fixed degree blades, spaced 7/16 in. on center. The outlet core shall have extruded aluminum receiving bar. Blades shall run parallel to the long dimension of the grille. The grille border shall be heavy duty extruded aluminum construction with factory mitered corners and reinforcing support bars for extra support for the core receiving bar. The support and receiving bars shall not exceed 8 in. on center. The core shall be held into the border with removable core clips allowing the removal of the core without special tools.
    b. Finish: The grille shall be finished in B12 White Powder Coat. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714.
    c. Manufacturer: Subject to compliance with requirements, provide linear bar grilles of one of the following:

        1) Agitair
        2) Metalaire
        3) Price
        4) Or equal

2.16 DUCTLESS COOLING UNITS

A. Evaporator:

1. General: The unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board, and fan motor. The unit in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, three-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from factory.
2. Cabinet: The casing shall be ABS plastic factory finish. Cabinet shall be designed for suspension mounting and horizontal operation. The rear cabinet panel shall have provisions for a field installed filtered outside air intake connection.
3. Fan: The evaporator fan shall have three high performance, double inlet, forward curve sirocco fans driven by a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of four speeds: Low, M1, M2 and Hi.
4. Vane: There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five vertical airflow patterns selected by remote control. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.
5. Filter: Return air shall be filtered by means of an easily removable washable filter.
6. Coil: The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

7. Control: The control system shall consist of two microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices. For A-Control, a three conductor 14 ga. AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. Where separate power is supplied to the indoor and outdoor units, a two 20 ga. AWG wire shall be run between the units to provide forbid-directional control communication. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

B. Condensing:

1. General: The outdoor unit shall be equipped with a control board that inferfaces with the indoor unit to perform all necessary operation functions. The outdoor unit shall be capable of operating at 0 degrees F, (-18 degrees C) ambient temperature without additional low ambient controls. The outdoor unit shall be able to operate with a maximum height difference of 100 ft. and have maximum refrigerant tubing length of 165 ft. between indoor and outdoor units without the need for line size changes, traps or additional oil. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.
2. Cabinet: The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a factory finish. The fan grille shall be of ABS plastic.
3. Fan: The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across if from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.
4. Coil: The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.
5. Compressor: The compressor shall be a scroll compressor with variable speed inverter technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain enough heat. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.
6. Electrical: The electrical power of the unit shall be as indicated on the drawings. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98 percent of input power supply.
7. Manufacturer: Subject to compliance with requirements provide DCU AC Units of one of the following:

    a. Mitsubishi Electric, Co.
    b. Sanyo
    c. Daikin
    d. Carrier
    e. Friedrich

f. Or Equal

2.17 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.

B. Low-Capacity Pumps

1. Pump: 8 GPH at 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.

2.18 FIRESTOP SYSTEMS

A. General: Provide firestopping at all 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.

2.19 WALL AND CEILING ACCESS DOORS

A. General: Furnish and install access panels, at all new construction where required for access to the Work of this Section. Furnish access doors for access to all concealed control valves, motor operated dampers, fire doors, and all other concealed parts of the HVAC system that require accessibility for the proper operation and maintenance of the system.

B. Refer to Section 083100 - Access Doors and Frames, for all product requirements for furnishing access panels.

C. Coordinate locations and schedule with the work of trades involved with construction in which access panels will be installed.

D. Access doors shall be heavy gauge steel with 1 in.frame. Door shall be fastened to frame with continuous piano hinge. Entire door and frame assembly shall be prime painted and be completed with cylinder lock and two keys. Door and frame shall match fire rating of wall or ceiling installed into.

E. Manufacturer: Subject to compliance with requirements, provide access doors of one of the following:

1. Inland Steel Products Company, "Milcor"
2. Walsh-Hannon-Gladwin Inc., "Way Loctor"
3. Or Equal.

2.20 AUTOMATIC TEMPERATURE CONTROLS

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 the latest version of the Niagara N4 platform. The Niagara platform provides an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time using a standard Web browser. Systems not developed on the Niagara N4 platform 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.
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 provided under Technology Section 270000.
4. Install an open-protocol (BACNet) energy management system (EMS) to monitor and rend the systems indicated on the control drawings:
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 indoor and outdoor CO2.
        4) 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 variable speed drives and other equipment with multiplexing capabilities may be used in lieu of specifying separate sensors.
        5) The classrooms bathrooms, corridors, storage and office areas, shall have stand-alone electric adjustable thermostat controls with occupied/unoccupied settings and override button.

    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 and all 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.
e. On VAV systems, the electrical sub-contractor will provide 120 VAC junction box with toggle switch at each location.

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 260000 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.

H. Networking Communications

1. 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.
2. 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)

3. 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.

4. 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).

5. 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:

        1) Auto-sense 10/100/1000 Mbps networks.
        2) IP Address will be assigned by Owner's IT staff.
        3) DNS and Gateway IP address will be provided by Owner's IT staff. A VLAN will be setup by Owner's IT staff.
        4) Allow access using Telnet.

6. 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.

7. The web server licensing options will allow concurrent access by 10 browser connections.
8. 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.

I. 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.

J. 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.

K. 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.

L. 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.

M. 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.

1. The DCCP (Duty Cycle Control Program) shall periodically stop and start loads according to various patterns.
2. 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.

1. 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.
2. PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.
3. 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.

4. 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.

N. 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) Variable Air Volume Terminal Boxes
        2) Fin Tube Radiation
        3) Convectors
        4) Radiant Heating Panels
        5) 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

O. Field Devices

1. Provide instrumentation as required for monitoring, control or optimization functions.
2. Room Temperature Sensors

    a. Office areas shall be provided with electronic stand alone room sensors with day / night setting and override button, and setpoint adjustment. Classroom and teaching room areas shall have electronic stand alone room sensors with day / night settings override button, and setpoint adjustment. Public areas such as corridors, entry areas, vestibules, restrooms and storage rooms shall have the same capabilities listed above.

    b. Add Alternate: Office areas shall be provided with digital room sensors shall have LCD display, day / night override button, and setpoint slide adjustment override options. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment. Classroom and teaching room areas shall have day / night override button, and setpoint slide adjustment override options. 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 without adjustment or occupied/unoccupied capability. Temperature sensors located in gymnasiums and locker rooms shall be provided with tamper proof guard. All temperature sensors shall be BACnet compatible network type.

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)

    c. Liquid immersion temperature:

Temperature monitoring range	+30/250 deg. F (-1 deg. /121 deg. C)
Output signal	Changing resistance
Accuracy at Calibration point	+0.5 deg. F (+/-0.3 deg. C)

    d. Duct (single point) temperature:

Temperature monitoring range	+20/120 deg. F (-7 deg. /49 deg. C)

Output signal	Changing resistance
Accuracy at Calibration point	+0.5 deg. F (+/-0.3 deg. C)

e. Duct Average temperature:

Temperature monitoring range	+20 deg.+120 deg.F(-7 deg./+49 deg. C)
Output signal	4 – 20 mA DC
Accuracy at Calibration point	+0.5 deg. F (+03 deg. C)
Sensor Probe Length	25 ft. L (7.3m)

f. Outside air temperature:

Temperature monitoring range	-58deg.+122deg.F(-50deg.Cto 50deg.C)
Output signal	4 – 20 mA DC
Accuracy at Calibration point	+0.5 deg. F (+/-0.3 deg. C)

3. Liquid Differential Pressure Transmitter

Ranges	0-5/30 in. H20 0-25/150 in. H20 0-125/750 in. H20
Output	4 – 20 mA DC
Calibration Adjustments	Zero and span
Accuracy	+-0.2 percent of span
Linearity	+-0.1 percent of span
Hysteresis	+-0.05 percent of span

4. Differential pressure:

a. Unit for fluid flow proof shall be Penn P74.

Range	8 to 70 psi
Differential	3 psi
Maximum differential pressure	200 psi
Maximum pressure	325 psi

b. Unit for air flow settings.

Set point ranges:	0.5 in. WG to 1.0 in. WG	(124.4 to 248.8 Pa)
	1.0 in. WG to 12.0 in. WG	(248.8 to 497.6 Pa)

5. Static pressure sensor:

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)
Output Signal	4 – 20 mA VDC
Combined static error	0.5 percent full range
Operating Temperature	-40 deg. to 175 deg. F (-40 deg. C to 79.5 deg. C)

6. Air Pressure Sensor:

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)
Output signal	4 to 20 mA
Accuracy	+1.0 percent of full scale

Humidity Sensors: All room/zone humidity sensors shall be BACnet compatible network type.

Range	0 to 100 percent RH
Sensing Element	Bulk Polymer
Output Signal	4 – 20 mA DC
Accuracy	At 77 deg. F(25 deg. C) + 2 percent RH

Humidistat:

Range	0 to 100 percent RH
Sensing Element	Bulk Polymer
Output Signal	4 – 20 mA DC
Accuracy	At 77 deg. F(25 deg. C) + 2 percent RH

7. Pressure to Current Transducer

Range	3 to 15 psig (21 to 103 kPa) or 3 to 30 psig (21 to 207 kPa)
Output signal	4 – 20 mA
Accuracy	+ 1 percent of full scale (+ 0.3 psig)

8. Carbon Dioxide Sensor : All CO_2 sensors shall be BACnet compatible network type and shall have a minimum 5 year calibration period.

Range	0 to 1500 ppm
Accuracy	20+ ppm

CO2 sensors located in gymnasiums and locker rooms shall be provided with tamper proof guard.

9. Control Valves all control valves shall have electric actuators tied into and controlled by the stand alone space thermostat.

a. Electric Control

Rangeability	40:1
Flow Characteristics	Modified. Equal percentage
Control Action	Normal open (fail open spring return)
Medium	Steam, water, glycol
Body Type	Screwed ends 2 in. and smaller, flanged Valves 2½ in. and larger
Body Material	Bronze
Body Trim	Bronze
Stem	Stainless Steel
Actuator	0-10 VDC, 4-20 MA modulating

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 five psi, whichever is less.

1) Positive positioning relays shall be provided on pneumatic control when required to provide sufficient power for sequencing.

10. Damper Actuators (Provide end switch)

a. Electric control shall be direct coupled actuators.
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 Johnson Inc. or approved equal using ISO900 registered procedures, and shall be Listed under Standards UL873 and CSA22.2 No. 24-93 I.

P. Miscellaneous Devices

1. Freezestats:

a. Install freezestats on each coil that mixes outside and return air (air handling units) 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 gauge 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.

Q. Manufacturers: The Automatic Temperature Control System shall be as manufactured by:

1. Delta Controls Proprietary
2. 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 for attic stock.
2. Provide one spare set of belts for each belt-driven air handling unit.
3. Obtain receipt from Owner that attic stock provided.

B. Ductwork Accessories

1. Furnish extra fusible links to owner, one link for every 10 fire dampers installed of each temperature range; obtain receipt.

C. Unit Heaters

1. Furnish to Owner, with receipt, (2) spare sets of filters per each unit.

D. Ductless Cooling Units

1. Furnish to Owner, with receipt, (2) spare sets of filters per each indoor unit.

E. Condensate Discharge Pumps

1. Furnish to Owner, with receipt, (10) new condensate pumps to attic stock.

F. Variable Refrigerant Flow (VRF) System

1. Furnish to Owner, with receipt, (2) spare sets of filters per each indoor unit.

3.2 CUTTING AND PATCHING

A. Penetrations through construction as required for the Work of this Section:

1. Coring: Perform all coring for required work.
2. Notify Masonry Sub-Contractor of exact locations and sizes for openings required in masonry, to be executed under Section 042000 – Unit Masonry, utilizing lintels furnished per Section 055000 – Metal Fabrications.
3. Cut openings in new and existing non-masonry construction where required for penetrations. All cutting shall conform to the requirements of Section 017329 – CUTTING AND PATCHING, and 024116 – BUILDING DEMOLITION.
4. Refer to Section 024116 – BUILDING DEMOLITION for restrictions on all alterations to structural elements.

B. Patching at penetrations through construction as required for the Work of this Section:

1. Notify Masonry Sub-Contractor when plumbing work is complete at penetrations through masonry construction, and ready for patching under Section 042000 – UNIT MASONRY.
2. Notify appropriate Sub-Contractors when plumbing work is complete at penetrations through non-masonry construction, and ready for patching under Sections in Division 9 - FINISHES.

3.3 INSTALLATION OF HANGERS & ATTACHMENTS

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. No Equipment shall be supported from the Roof Deck. No attachments shall be made at the Roof Deck. This Contractor to provide Unistrut from Beams instead of attaching to Roof Deck.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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 spacing 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 in. provide heavy gauge shield at each hanger point.
    c. Saddles: For all pipe sizes over 4 in. provide saddle at each hanger point. Completely fill void in saddle with loose insulation.

H. 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.

I. Fabricate and install anchor by welding steel shapes, plates, and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

J. 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.

K. Anchor Spacing: 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.

L. Concrete housekeeping bases shall be provided by General Contractor for all floor-mounted equipment. Size bases to extend minimum of 4 in. beyond equipment base in any direction; and 4 in. 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.

M. 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.

N. 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.

3.4 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 ft. along each piping run, except reduce spacing to 25 ft. 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 in. high lettering for name of unit where viewing distance is less than 2 ft. – 0 in., 1/2 in. high for distances up to 6 ft. – 0 in. 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.

3.5 INSTALLATION OF MECHANICAL INSULATION

A. Installation of Piping Insulation:

1. Insulation Omitted: Omit insulation on hot piping within radiation enclosures which serve the zone: on cold piping within unit cabinets provided piping is located over drain pan. (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. Do not cover calibrated balance valves until testing adjusting and balancing has been completed.
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 in. 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 in. wide vapor barrier tape or band.

B. Installation of Ductwork Insulation:

1. General: Do not insulate ductwork until ductwork has been sealed successfully, pressure tested, and approved for application of insulation by engineer or commissioning agent. 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. Installation of Equipment Insulation:

1. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
2. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
3. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
4. Do not apply insulation to equipment, breechings, or stacks while hot.
5. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
6. Coat insulated surfaces with layers of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
7. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2 in. Apply over vapor barrier where applicable.
8. Do not insulate handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruption of insulation.
9. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

D. 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.

3.6 INSTALLATION OF HYDRONIC 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.

D. Grooved Ends:

1. Roll Groove pipe ends in accordance with the latest published instructions from manufacturer of grooved couplings.
2. Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. All grooved system components shall be of same manufacturer. Use grooved-end fittings and rigid or flexible, where required, grooved-end-pipe couplings. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.

3. Training

    a. The grooved coupling manufacturer's (the "manufacturer") factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of groove joints products.
    b. IACET/Training: A factory trained manufacturer's representative (direct employee) shall provide on-site training of contractor's field personnel in the use of grooving tools, application of groove, and product installation in compliance with the following:
        1) Manufacture must be accredited by the International Association for Continuing Education and Training (IACET).
        2) IACET Accredited Provider status demonstrates that the manufacture complies with the ANSI/IACET standard, which is recognized internationally as a standard of excellence in instructional practices.

4. Inspection

    a. A manufacture's factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies.

    b. The grooved fittings manufacturer's product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Inspection Services prior to the completion of the project. Any Victaulic product that has not been corrected or was not examined will not be considered as part of the successful completion of Inspection Services.

5. Application

    a. Upon completion of the manufacturer's inspection of the installation and any identified corrections, the manufacturer may provide the Owner or purchaser with a limited warranty on manufacturer's products.

E. 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.
    b. Throttling Duty: Use globe, ball, and plug valves.

2. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

F. 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.

G. 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.

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, and other design consideration. So far as practical, install piping as indicated.
2. Install pipe sleeves at all wall and floor penetrations.
3. Install escutcheons at all exposed pipe wall penetrations.

3.8 INSTALLATION OF HVAC ROOFTOP UNITS (RTU)

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: 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: Contractor shall coordinate installation with the roofing contractor, and 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. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

E. Duct Connections: Provide ductwork, accessories, and flexible connections as indicated.

F. Grounding: Provide positive equipment ground for air-handling unit components.

G. Provide two complete extra sets of filters for each air handling unit. Install new filters at completion of air handling system work, and after completion of testing, adjusting, and balancing work in accordance with MA-CHPs requirements. Obtain receipt from Owner that new filters have been installed.

H. Provide one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

I. Electrical Connections: Refer to electrical sections for final connections to equipment and installation of loose shipped electrical components.

J. 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.

K. Operating and Maintenance Training:

1. Provide services of manufacturer's service representative (minimum 8 hrs.) 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 trouble-shooting 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.

L. Provide two cases on spare filters for each rooftop unit, both final filters and pre-filters for the energy recovery wheel. Obtain receipt from Owner that stock of spare filters has been received.

3.9 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. 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.

F. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

G. Testing: After installation of ventilators has been completed, test each ventilator to possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

H. Cleaning: Clean factory-finished surface. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

I. General: Furnish to Owner, with receipt, four spare set of belts for each belt driven power ventilator.

3.10 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 Electric Heating Terminals:

1. Install electric heating terminal units including components as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices; complying with applicable installation requirements of NEC and NECA's "Standard of Installation".
2. Coordinate with other electrical work, including wiring/cabling, as necessary to properly interface installation of heating terminal units with other work.
3. Clean dust and debris from each heating terminal as it is installed to ensure cleanliness.

4. Comb out damaged fins where bent or crushed before covering elements with enclosures.
5. Touch-up scratched or marred heating terminal enclosure surfaces to match original finishes.
6. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminal to comply with tightening torques specified in UL Std. 486A.

C. Grounding:

1. Provide equipment grounding connections for electric heating terminals as indicated, Tighten connections to comply with tightening torque values specified in UL std. 486A to assure permanent and effective grounding.

D. Electrical Wiring:

1. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.

   a. 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.
   b. Upon completion of installation of electric heating terminals, and after building circuitry has been energized, test heating terminals to demonstrate capability and compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
   c. Replace electric heating terminals and accessories which are damaged and remove damaged items from construction site.

E. 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.

3.11 INSTALLATION OF VARIABLE REFRIGERANT VOLUME SYSTEM

A. 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.

B. 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. Install condensing units on a flat surface level within 1/8 inch, and elevated a minimum of 18” from ground or roof surface. Provide intermediate supports as recommended by the equipment manufacturer.
   4. Provide all necessary control wiring as recommended by the manufacturer.
   5. High/low pressure gas line, liquid, and suction lines must be individually insulated between the outdoor and indoor units.
   6. Contact DXS (978-977-9911) prior to installation to review and confirm piping layout and lengths.
   7. Use refrigeration best practice to allow pipes to expand and contract freely. Review manufacturer installation instructions to ensure expansion joints are properly designed.
   8. 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.

C. 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.

D. 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.

3.12 INSTALLATION OF METAL DUCTWORK

A. Installation of Metal Ductwork:

   1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (five percent leakage for systems rated 3 in. and under; one percent for systems rated over 3 in.) 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 in. 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".

B. Installation of Duct Liners:

1. General Install duct liners in accordance with SMACNA "HVAC Duct Construction Standards".

C. Installation of Flexible Ducts:

1. Maximum Length: For any duct run using flexible ductwork, do not exceed 4 ft.-0 in. extended length.
2. Installation: Install in accordance with Section II of SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible".

D. Field Quality Control:

1. Leakage Tests: After each duct system that is constructed pressure test each system for duct leakage in accordance with SMACNA "HVAC Air Duct Leakage Test Manual". Repair leaks and repeat tests until total leakage is less than 5 percent of system design air flow.

E. 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.

F. 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. 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.
3. 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.

G. Construction IAQ Management:

1. Follow the SMACNA guidelines for “Duct Cleanliness for New Construction Guidelines” according to advanced levels of cleanliness. Including but not limited to:

    a. Specify that ductwork be sealed when transported to the construction site
    b. Store ductwork in clean, dry conditions and keep sealed while it is stored.
    c. Wipe down internal surfaces of ductwork immediately prior to installation to remove dust.
    d. Seal open ends on completed ductwork and overnight work-in-progress.
    e. During installation, protect ductwork waiting to be installed with surface wrapping.

f. During construction, seal HVAC supply and return openings to protect them from dust infiltration.

3.13 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 volume and/or 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.

3.14 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.

3.15 INSTALLATION OF SOUND ATTENUATORS

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: 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.

3.16 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.

3.17 INSTALLATION OF DUCTLESS COOLING UNIT SYSTEMS

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.

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. Provide the services of manufacturer’s service representative (two hours minimum) to instruct the Owner's maintenance personnel on start-up and shut-down procedures, troubleshooting procedures, controller features, and servicing and preventative maintenance schedules and procedures.
2. Schedule training with Owner through the Architect/Engineer with at least seven days prior notice.

3.18 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.

    a. 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.

3.19 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 078110 - THROUGH PENETRATION FIRESTOP SYSTEMS, for all installation requirements for maintaining integrity of fire-rated construction at penetrations.

3.20 INSTALLATION OF WALL AND CEILING ACCESS DOORS

A. General: Install access doors in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

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 item or part can be easily reached, and the size shall be sufficient for this purpose (minimum size 12 in. X 16in.). Furnish access doors to permit thorough inspection. When access doors are required in corridors, lobbies, or other habitable areas, they shall be located as directed by the Architect.

3.21 AUTOMATIC TEMPERATURE CONTROLS (DDC)

A. Installation Of Automatic Temperature Controls (DDC):

1. Installation of Control Systems:

a. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
b. 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.

1) Install circuits over 25-volt with color-coded No. 12 wire in electric metallic tubing.
2) Install circuits under 25-volt with color-code No. 18 wire with 0.031 in. high temperature 105 degrees F. (41 degrees C) plastic insulation on each conductor and plastic sheath over all.
3) Install electronic circuits with color-coded No. 22 wire with 0.023 in. polyethylene insulation on each conductor with plastic-jacketed copper shield over all.
4) Install low voltage circuits, located in concrete slabs, masonry walls, or in mechanical areas, in electrical conduit. Where exposed in occupied areas install all wiring in wiremold.
5) Power sources from lighting circuits and wall outlets shall not be used to power DDC controllers.

c. Controllers and safety devices:

1) All safety devices such as freezestats, duct mounted heat detectors, and smoke detectors shall be hard wired to shut down the fans independently. Provide audible alarm with silence switch as well as DDC indication.
2) 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.
3) All supply, return and exhaust fans shall be provided with pressure differential switches. Current sensing devices, starter auxiliary contacts, and relay contacts are unacceptable proof of fan operation.
4) 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.

2. Adjusting and Cleaning:

a. Start-Up: Start-up, test, and adjust DDC control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
b. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

c. Final Adjustment: After completion of installation, adjust thermostats, control valves, motor and similar equipment provided as work of this section.

1) Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3. Closeout Procedures:

a. Owner's Instructions: Provide services of manufacturer's technical representative for 40 hours of onsite instruction on running and basic troubleshooting of DDC control system.

b. 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.

1) Witnessed validation demonstration shall consist of:

a) Execute digital and analog commands in English and graphic mode.
b) Demonstrate all specified diagnostics.
c) Demonstrate scan, update, and alarm responsiveness.

c. Training:

1) All training shall be by the automatic temperature control contractor and shall utilize specified manuals and as-built documentation.

2) Operator training shall include:

a) Sequence of Operation review.
b) Sign on-Sign off.
c) Modifying warning limits, alarm limits and start-stop times.
d) System initialization.
e) Use of Portable Operators Terminal.
f) Troubleshooting of sensors (determining bad sensors).
g) Point disable/enable.
h) Software review of Sequence of Operation programs.
i) Modification of control programs.
j) Add/Delete/Modify data points.
k) Use of diagnostics.
l) Review of initialization.

3) Training shall be for Owner-designated personnel at the subject site, and shall be scheduled by the Owner with two week notice.

4) All training sessions shall be videotaped.

4. Perform Indoor Air Quality Management Building flush out procedures and adhere to IAQ Management Procedures referenced in Section 018120 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT.

3.22 TESTING, ADJUSTING, AND BALANCING

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. The entire project is considered phased construction, and as such, as each phase of construction is completed the appropriate balancing for that phase of work shall be completed. At the completion of all phases of construction each previous phase of completed balancing must be re-checked and re-adjusted accordingly to match final design conditions. A preliminary report of each phase of construction will be submitted for approval during each phase of construction, and a final balancing report including all phases of construction will be submitted at the completion of the project.
3. 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. Verify temperature control system operation.

4. Do not include:
    a. 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.

5. Comply with Commissioning Test Requirements.

6. Comply with Indoor Air Quality Management Building flush out procedures and adhere to IAQ Management Procedures referenced in SECTION 018120 – CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT.

    a. All rooftop units shall operate at the maximum amount of outside air (the design outside airflow rate for maximum occupancy as indicated on the mechanical schedules) during and after the installation of VOC emitting materials for the maximum amount of time feasible, but not less than continuously (i.e. 24 hours) for seven days. During this time, the design temperature and humidity set points shall be maintained. The installation of VOC emitting materials shall be fully coordinated with the Architect.
    b. If the project has fallen behind schedule and cannot run the equipment for the required period of time (24 hours for seven days), the flush-out can alternatively be performed while the building is occupied provided all of the following measures to protect building occupants are taken prior to their use of the space: percent

        1) All of the rooms in the school must be inspected for health and thermal comfort by a trained technician or a certified Industrial Hygienist before occupancy. The occupancy evaluation report must be reviewed and approved by a certified Industrial Hygienist (i.e. certified by the American Council of Government and Industrial Hygienists (ACGIH) shall be submitted to CHPS showing the following elements have been met at a minimum:

            a) Each classroom has been tested to show that the ventilation rate meets minimum code required ventilation rate and receives continuous ventilation during occupancy, per Title 8, Sec 5142.

b) The HVAC filters on all HVAC units are properly in place and meet the MERV rating as specified for the project, the HVAC condensate pans drain correctly and internal HVAC insulation undamaged.
c) Each classroom has been tested to show that particulate matter, PM 10, has measured to be 20 micrograms per cubic meter or less than the outdoor air levels and the PM 2.5 12 micrograms per cubic meter or less than outdoor air levels.
d) Each classroom has been tested to show that the carbon monoxide has been measured and is less that 9 parts per million but not greater than 2 ppm above outdoor levels. Each classroom has been tested to show that the carbon dioxide has been measured and is less than 200 ppm above outdoor CO2 levels nearby. The room must be unoccupied during testing, and testing should occur during at least on rush-hour period.
e) Each classroom has been tested to show that the temperature and relative humidity have been measured and are within the criteria in the current ASHRAE Standard 55.

2) Each classroom has been inspected and observed to ensure that there are no health or safety concerns from any chemical, moisture and odor sources in or near the classrooms.

a) Conduct the flush-out for 24 hours a day of continuous ventilation for a total of days necessary for all supply fans at their maximum rate and position. Thermal comfort is maintained during occupied hours, per the criteria in the current ASHRAE Standard 55. Internal temperatures are maintained at the most energy efficient level above 60 deg. F; relative humidity is maintained no higher than 60 percent during non-occupancy hours. Under conditions where the heating can't be met (60 deg. F) at that fan speed, then adjust the fan to meet the 60 deg. F.
b) All air handling unit dampers are at their maximum outdoor air position during the 14 day flush-out

3) Post-occupancy ventilation: When the contractor is required to perform touch-up (including furniture after occupancy) work involving products with chemical emissions, provide temporary construction ventilation during application and extend the building flush-out by a minimum of four days after touch-up application, with 100 percent tempered outside air for 24 hours each day.

c. All unit filters to be replaced upon completion of flush-out

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.

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 5E F. wet bulb temperature of maximum summer design condition, and within 10E 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. 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 percent. 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 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, or lack of access.
b. Upon completion of system deficiencies, Balancing Contractor shall balance and record data.

END OF SECTION

SECTION 230548

Vibration Control and Seismic Restraint

END OF INDEX

SECTION 230548

Vibration Control and Seismic Restraint

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. 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.

1.2 DESCRIPTION

A. General: The work noted within Section 230548 is referenced by Divisions 210000, 220000, 230000, 260000. Provide all necessary labor and 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. Mechanical, Plumbing, 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).

Air Handling Units	Generators
Battery Racks	Light Fixtures
Bus Ducts	Piping
Cable Trays	Pumps (all types)
Conduit	Switching Gear
Ductwork	Tanks (all types)
Electrical Panels	Transformers
Fans (all types)	Unit Heaters
Roof Top Units	Switching Gear
	Tanks (all types)
	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 and relief systems on emergency control sequence including air handlers, conduit, duct, dampers, boilers, pumps, valves, and roof top units.

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 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 Division 01, 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 2009 with an effective peak acceleration coefficient of 0.15.
2. Massachusetts State Building Code, Eighth 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 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, boilers, pumps, tanks, and transformers including roof mounted equipment.

C. Attachments:

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, anchors, and building fasteners 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 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 in. thick neoprene pad consisting of 2 in. 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 in. 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 two 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 three 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 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 in. 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 percent 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 in. 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. Hangers shall consist of rigid steel frames containing minimum 1 1/4 in. 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 deg. arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30 deg. capability. Hangers shall be type 30 deg. as manufactured by Mason Industries, Inc.
9. 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 deg. capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.

10. 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.
11. 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.

12. 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.
13. 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.
14. 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.
15. 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 in. 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 in. nor more that 1/4 in.. Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8 in. 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 in. 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.

16. 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.
17. 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.
18. 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 2 in. 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 and 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 and 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 structural steel dunnage. Air handling unit load shall be properly distributed. Coordinate curb construction with pitch of roof. Positive attachment of the curb to the structure is imperative. 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, and building attachments 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 in. 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 in. 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 and 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 and Return air duct openings. Openings shall match duct sizes and have 1 in. 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 in. 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 and ASTM G21 bacterial tests conducted in accordance with ASTM G22. Floors up to 90 in. 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 percent 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 percent open area inside panels. Plenum divider shall be double wall 22 Ga. perforated galvanized 22.7 percent 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,

19. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3 in. 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.

20. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2 in. 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.
21. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2 in. 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 in. motion, or to meet location requirements. Pipe guides shall be type VSG as manufactured by Mason Industries, Inc.
22. Split Wall Seals consist of two bolted pipe halves with minimum 3/4 in. 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 in. past either face of the wall. Where temperatures exceed 240 deg. F., 10# density fiberglass may be used in lieu of the sponge. Seals shall be Type SWS as manufactured by Mason Industries, Inc.

EXECUTION

2.3 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 contractors expense.

H. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractors 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 in. 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.

2.4 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 in. I.D. and larger.
   c. All other piping 2 1/2 in. diameter and larger.

2. Transverse piping restraints shall be at 40 ft. maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
3. Longitudinal restraints shall be at 80 ft. 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 ft. maximum and longitudinal restraints at 40 ft. 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 in. 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 ft. total pipe length of connected vibration-isolated equipment (chillers, pumps, air handling units, pressure reducing stations, generators, air compressors, cooling towers, pumps, compressors, and roof top units;
   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 in., Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to 1/2 in., 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 in. 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 in. or larger.
   c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.

2. Transverse restraints shall occur at 30 ft. 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 ft. 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 ft. 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 ft. total duct length of connected vibration-isolated equipment (whichever is longer) shall
   be isolated from the building structure by Type FN, PCF or HN isolators. All isolators shall achieve 0.1 in. minimum static deflection.
2. Ducts within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
3. 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. 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 ft. 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 ft. 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 ft. 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.

2.5 SEISMIC RESTRAINT EXCLUSIONS

A. General:

1. Fire Protection, Plumbing, Mechanical and Electrical Components to be installed within seismic design category “B” shall be exempt from the seismic requirements within this specification in accordance with ASCE-7 (2010). Refer to the Structural Drawings and Specifications for Project Design Category.

B. Piping:

1. All piping less than 2 1/2 in. except for gas and fire protection piping.
2. All piping in boiler and mechanical equipment rooms less than 1 1/4 in. I.D.
3. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12 in. 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. in diameter and smaller.

C. Ductwork:

1. Rectangular, square or oval ducts less than 6 sq.ft. in cross sectional area.
2. Round duct less than 28 in. in diameter.
3. Duct supported by hanger rods where the point of attachment is less than 12 in. in length from the structure to the structural connection of the duct work.

D. Electrical:

1. All conduit less than 2 1/2 in. 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 12 in. in length from the structure to the structural connection of the clevis or trapeze.

2.6 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. 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.
4. 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.
5. Hanger rods for vibration-isolated support shall be connected to major structural members, not the floor slab between major structural members. Provide suitable intermediate support members as necessary.
6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360 deg. about the rod axis without contacting any object.
7. Parallel running pipes may be hung together on a trapeze that is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and unisolated pipes on the same trapeze.
8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
10. 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 during normal operation. Adjust isolators to provide 1/4 in. clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.
11. 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 in. 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 26 00 00

ELECTRICAL
(File Sub-Bid Required)

END OF INDEX

SECTION 26 00 00

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 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: 26 00 00 – 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 or may be obtained by written or telephone request.

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:

1. Sub-bidders' attention is directed to Massachusetts General Laws, Chapter 149, Section 44F as amended which provides in part as follows:

   a. Each sub-bidder shall list in Paragraph E of the "form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which (the Section of the specifications for that sub-trade) requires such listing; provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his/her own name in said paragraph E for any such class of work or part thereof and perform that work with persons on his/her own payroll; if such sub-bidder, after sub-bid openings, shows to the satisfaction of the awarding authority that s/he does customarily perform such class of work or the part thereof with persons on his/her own payroll and is qualified so to do. This Section of the Specifications requires that the following classes of work shall be listed in paragraph E under the conditions indicated herein.

CLASSES OF WORK	SECTION NUMBER
None	

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: E0.01,E0.02, E0.03, E1.11, E1.12, E2.11, E2.12, E3.01, E3.02, E3.03, E3.04, E4.01, E4.11, E4.12, ED1.11, ED1.12.

1. Any scope specifically referenced on one of the drawings above and described on another drawing is also part of the scope of this filed sub-bid contractor.

E. The listing of the Contract Drawings above shall not limit the subcontractor's responsibility to determine the full extent of work of this Section as required by all Contract Drawings noted on the Contract Drawings including the Title Sheet Drawing List, the Project Manual, and Addenda.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DESCRIPTION OF WORK

A. Work described herein shall be interpreted as work to be done by the Electrical Subcontractor. Work to be performed by other trades will be referenced to a particular contractor or subcontractor.

B. The scope of work shall include providing all work indicated, and coordination with all trades. Scope of work is indicated on the contract documents including the drawings and specifications, which are complimentary. Work indicated in any contract document shall be considered part of the scope of work. Where the documents conflict within themselves or with codes and regulations, provide the higher quantity or quality and follow the stricter requirements.

C. Provide all labor, materials, tools, and equipment, 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 reference in singular or plural terms, also refer to drawings to confirm quantities. 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, surge protective devices, Variable Frequency Drives, motor controls, distribution panels, and panelboards including feeders and subfeeders.
3. Fire alarm system, addressable with voice evac.(proprietary system; extension of existing Notifier NFS 3030)
4. Emergency power system, including battery units, emergency lighting and exit signs.
5. Lighting systems exterior and interior fixtures, and lighting control system with all sensors occupancy, daylight, photosensors, and switches.
6. Excavation and backfill within building foundation walls for any underground raceways.
7. All raceway systems, including boxes, couplings, and fittings.
8. All branch circuit wiring systems, including wiring devices, plates.
9. Connections for all building equipment, including heating, ventilation and air conditioning, plumbing, fire protection, elevators and the like.

10. All testing of equipment installed. Provide and coordinate required electrical manufacturer's site testing and installation verifications. Identify and coordinate any Factory testing and make provisions for necessary site personnel (e.g., maintenance personnel, client, Cx agent, and engineer of record) to attend FAT execution.
11. Drilling, Coring and Cutting of holes and openings where the largest dimension thereof does not exceed 12 inches, for Electrical conduit, wiring, and Equipment.
12. Scaffolding, Rigging, and Staging required for all Electrical work.
13. Systems Identification.
14. Firestop systems in accordance with section 078400 – Firestopping
15. Provide Seismic Restraints for all Electrical Systems conforming to the requirements of Section 230548 which Section is herein incorporated by reference.
16. Coordination Drawings, refer to section 013100.
17. Communications cable tray, outlet boxes and raceway system provisions including voice, data, paging, intercom, and clock. as indicated on drawings.
18. Raceways system provisions for Technology systems including outlet boxes, raceway system, 120 volt sources as indicated on drawings. Raceways system provisions for Technology systems including outlet boxes, raceway system, 120 volt sources as indicated on drawings.
19. Raceways system provisions for Integrated Electronic Security System including outlet boxes, raceway system, 120 volt sources as indicated on drawings. Raceways system provisions for Integrated Electronic Security System including outlet boxes, raceway system, 120 volt sources as indicated on drawings. The intrusion detection system is existing to remain and shall be protected, The access control system (Lenel) and CCTV (Avigilon) devices, wiring and programming will be provided by the owners ITC71 vendor. E.C. shall coordinate requirements with owners ITC71 vendor.
20. Selective Demolition requirements as shown on drawings and per Section 024100
21. Surface metal raceway system.
22. Commissioning requirements per Section 018100.
23. Emergency Responder radio signal amplification system (BDA system)
24. Any other item of work hereinafter specified or indicated on electrical drawings.

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:

1. Provide: Furnish and install completely connected up and in operable condition.
2. Furnish: Purchase and deliver to a specific location within the building or site.
3. Install: With respect to equipment furnished by others, install means to receive, unpack, move into position, mount and connect, including removal of packaging materials.
4. Conduit: Raceways of the metallic type which are not flexible. Specific types as specified.
5. Connect: To wire up, including all branch circuitry, control and disconnection devices so item is complete and ready for operation.

6. Subject to Mechanical Damage: Equipment and raceways installed exposed and less than eight feet above finished floor in mechanical rooms or other areas where heavy equipment may be in use or moved.

1.5 ITEMS TO BE FURNISHED ONLY

A. Furnish the following items for installation under designated sections.

1. Duct type smoke detectors – SECTION 230000, HVAC.
2. Access Doors and Frames - Section 08 31 00.

1.6 ITEMS TO BE INSTALLED ONLY

A. Install the following items furnished under designated sections.

1. Power operated projection screens – Section 115210.

1.7 RELATED WORK

A. The following related work is to be performed under designated sections.

1. Concrete Pads and duct envelopes: SECTION 033000, CAST-IN-PLACE CONCRETE.
2. Finish Painting: SECTION 099007, PAINTING AND COATING.
3. Temporary Facilities and Controls: Section 015000.
4. Excavation and Backfill (except within building foundation): DIVISION 31 - EARTHWORK.
5. Automatic Temperature Control: SECTION 230000, HEATING, VENTILATING, AND AIR CONDITIONING.
6. Insulation: SECTION 072100 – THERMAL INSULATION.
7. Payment for energy for temporary light and power shall be made by General Contractor.
8. Patching: To be done by trade responsible for surface requiring patching.
9. Hardware: SECTION 087100, DOOR HARDWARE.
10. Temporary light and power: DIVISION 01 – GENERAL REQUIREMENTS.
11. Powered Athletic equipment - SECTION 116620 GYMNASIUM EQUIPMENT
12. Access Panels: Access panels will be furnished under this section but installed under Section 083100. Refer to Section 083100 for access panel requirements.
13. Automatic Temperature Control: SECTION 230000 – AUTOMATIC TEMPERATURE CONTROLS.

1.8 INSPECTION OF SITE

A. Electrical bidders shall inspect site. Failure to inspect existing conditions or to fully understand work which is required shall not excuse Electrical Subcontractor from its obligations to supply and install work in accordance with specifications and the drawings and under all site conditions as they exist.

1.9 CONTRACTOR'S REPRESENTATIVE

A. Retain a competent representative on the project. Do not substitute representative without prior approval from Owner.

1.10 COOPERATION

A. Work shall be carried on under usual construction conditions, in conjunction with other contractors work. Cooperate with other contractors, coordinate work and proceed in a manner as not to delay progress.

B. Before proceeding, examine all construction drawings and consult other contractors to coordinate installation and avoid interference.

C. In case of dispute, the Architect will render a decision in accordance with General and Supplementary General Conditions.

1.11 CODES, ORDINANCES, AND PERMITS

A. Codes and Ordinances:

1. All material and work provided shall be in accordance with the following codes and standards as most recently amended.

   International Building Code (IBC) with Massachusetts Amendments

   International Existing Building Code (IEBC) with Massachusetts Amendments

   National Electric Code, 2020 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 (IEBC) with Massachusetts Amendments

   NETA, National Electrical Testing Association

   City of Newton

2. Where contract documents indicate more stringent requirements than codes, the contract documents shall take precedence.

B. Permits: Be responsible for filing documents, payment of fees, and securing of inspection and approvals.

C. The Owner will pay back-charges for utility company work in conjunction with the permanent electric service.

1.12 ELECTRICAL ROOMS OR SPACES

A. Be responsible for ensuring that the dedicated space and clearances required in the NEC, Sections 110-26 and 110-16 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.

1.13 SUBMITTALS

A. Refer to Section 013300 – SUBMITTAL PROCEDURES for information relative to submission of shop drawings. No equipment for which review is required shall be installed prior to review, except at Contractor's own risk. Shop Drawings will be required for all electrical equipment.

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.

1.14 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.

D. Electrical Contractor is responsible to provide and/or install the correct designated equipment, components, and materials. Submittal approval by the engineer does not relieve the contractor from any contractual requirement to provide a complete and fully working system.

1.15 ELECTRICAL CHARACTERISTICS

A. In general, and unless specifically indicated otherwise, all building service, heating, ventilating, air conditioning, and plumbing equipment shall be of the following characteristics.

1. Motors up to and including 1/3 HP shall be suitable for 120 volts, one phase operation.
2. Motors larger than 1/3 HP shall be suitable for 480 volts, three phase operation.
3. Electric heating equipment 4.0 KW and less shall be suitable for 277 volt single phase operation. Over 4.0KW shall be 480 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.

1.16 TEMPORARY ELECTRICAL SUPPORT FACILITIES

A. Refer to and comply with DIVISION 01 – GENERAL REQUIREMENTS and the following:

B. Provide own field office and/or storage facilities which shall be located as directed or permitted by General Contractor and in accordance with local regulations. 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.

1.17 RECORD DRAWINGS

A. Refer to Section 017700 – CLOSEOUT PROCEDURES for requirements and the following;

B. 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.

C. Any addenda sketches and supplementary drawings issued during course of construction shall be attached to drawings.

D. At completion, submit an accurate checked set of drawings.

E. After approval of these drawings, drawings shall be revised to incorporate changes, including addenda sketches and supplementary drawings. These “as-built” drawings shall be certified as correct and delivered to the Architect. Provide an Auto CAD CD of final record drawings.

1.18 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Refer to and comply with DIVISION 01 – GENERAL REQUIREMENTS and the following:

B. Operating Instructions: 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 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.

C. Maintenance Manuals:

1. 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 binders.

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 and switchboards shall have phases balanced as near as practical. A consistent phase orientation shall be adhered to at all terminations.

C. Provide and coordinate required electrical manufacturer's site testing and installation verifications. Site testing protocols shall be submitted by the applicable vendor PRIOR to commencement of site tests. All completed site testing is to be properly documented with test reports submitted as a Cx pre-requisite. Identify any Factory testing and make provisions for necessary site personnel (e.g., maintenance personnel, client, Cx agent, and engineer of record) to attend FAT execution.

D. Provide all necessary technical and material support for the commissioning of the project's electrical components and systems. After establishing a general project schedule, add pertinent details of the commissioning workplan, incorporating necessary Cx predecessors, successors, and durations. Obtain/execute/submit all required documentation necessary for Cx to commence

1.20 RETURN AIR PLENUM

A. In areas above hung ceiling. All wiring systems including telephone and/ or data, shall either be run in conduit or shall be "UL listed" for the environment in which they are installed.

1.21 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-installation.

1.22 OWNER FURNISHED EQUIPMENT

A. The owner will furnish certain materials, which will be installed and wired under this Section of the specifications. Owner furnished equipment will be specified under the Product Sections of these Specifications.

B. This contractor shall be responsible for handling, storing, and inventory of owner furnished equipment. The contractor shall be responsible in all aspects of material handling and shall provide for “tailgate” delivery.

1.23 COORDINATION DRAWINGS

A. General: Refer to DIVISION 01 for general requirements for the preparation and submittal of coordination drawings.

B. Coordination requirements specific to the Work of this Section include the following:

1. 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, pull boxes, etc. relevant to the complete system. Ensure that these Drawings are compatible and correctly annotated and cross-referenced at their interfaces.

1.24 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 this Contractor.

1.25 SEQUENCING

A. Phasing: Refer to Division 01 – General Requirements, and Drawings for phasing and milestone completion requirements which affect the Construction Manager's Work and the Work of this Trade Contractor.

B. Coordinate work of this Trade Contract with that of other trades, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

C. Do not order or deliver any materials until all submittals, required in the listed Specification Sections included as part of this Trade Contract, have been received and approved by the Architect.

D. 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

1.26 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 this contractor, as specified under Section 015000, TEMPORARY FACILITIES AND CONTROLS.

1.27 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 01500 Construction Facilities and Temporary 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.

1.28 PHASING AND DEMOLITION

A. During the execution of the work, required relocation, and rerouting of existing equipment and systems in the existing building areas where new work is to be installed or new connections are scheduled to be made, shall be performed by the Electrical Subcontractor, as required by job conditions and as determined by the Architect in the field, to facilitate the installation of the new system, while demolition, relocation work or new tie-ins will be performed. Outages required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the Owner's designated representative, for specified, mutually agreeable periods of time, after each of which the interruption shall cease and the service shall be restored. This procedure shall be repeated to suit the Owner's working schedule, as many times as required until all work is complete. Any outages of service shall be approved by the Owner, prior to commencing the work. No outages or shutdowns of service shall occur without the written authorization of the Owner prior to commencing the work. Give notice of any scheduled shutdowns, a minimum of two weeks in advance. Owner shall make their best effort to meet this request without adversely affecting the electric service to the existing building.

B. Prior to any deactivation and relocation or demolition work, consult the drawings and arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.

C. Where existing outlets are to be reused and are cut off by the remodeling, they shall be reconnected to existing circuits as required by field conditions. Where existing outlets are to be abandoned, they shall be removed and blank plates installed. Each bidder shall, before submitting his bid, visit the site and make a thorough examination of the conditions in the existing buildings in order to determine the extent of the work to be done. Prior to disconnecting and removing panelboards, field confirm that it does not service areas or circuits scheduled to remain.

D. All deactivation, relocation and temporary tie-ins of electrical systems and equipment shall be provided by the Electrical Subcontractor. All demolition and removal of electrical systems and equipment designated to be demolished shall be by the Electrical Subcontractor and removed by the Construction Manager. Stack all demolished electrical materials except hazardous materials (lighting ballasts, fluorescent lamps) nearby for removal by the Construction Manager. All hazardous electrical materials shall be legally disposed by the Hazmat Contractor. The Hazmat Contractor will remove lamps and ballasts from light fixtures.

E. The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.

F. Phasing

1. The Electrical Subcontractor shall construct the subject in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

2. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the Architectural drawings.

1.29 TRADE RESPONSIBILITY FOR INTERCONNECTIONS MATRIX

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
Smoke Detectors (Area type)	26 00 00	26 00 00	26 00 00	230000 (ATC)	26 00 00	
Smoke Detectors (RTU mounted)	23 00 00	23 00 00	26 00 00	230000 (ATC)	26 00 00	
Smoke & Fire/Smoke Dampers	23 00 00	23 00 00	N/A	N/A	N/A	
Smoke & Fire/Smoke Damper Actuators	23 00 00	23 00 00	26 00 00 & 230000 (ATC)	230000 (ATC)	26 00 00	2
Fire Dampers	23 00 00	23 00 00	N/A	N/A	N/A	
VAV Boxes	23 00 00	23 00 00	26 00 00	230000 (ATC)	N/A	2
VAV Box Damper Actuator	230000 (ATC)	Box Mfr	230000 (ATC)	230000 (ATC)	N/A	2
VAV Box DDC Controller	230000 (ATC)	Box Mfr	230000 (ATC)	230000 (ATC)	N/A	2
Hydronic Control Valves	230000 (ATC)	23 00 00	N/A	230000 (ATC)	N/A	1
Hydronic Control Valve Actuator	230000 (ATC)	23 09 23	230000 (ATC)	230000 (ATC)	N/A	1
Sheet Metal Damper	23 00 00	23 00 00	N/A	N/A	N/A	1
Sheet Metal Damper Actuators	230000 (ATC)	23 09 23	230000 (ATC)	230000 (ATC)	N/A	1
Electrical Energy Meters	26 00 00	26 00 00	26 00 00 & 230000 (ATC)	230000 (ATC)	N/A	3
Domestic Water Meters	23 00 00 (ATC)	22 00 00	26 00 00 & 230000 (ATC)	230000 (ATC)	N/A	3
HVAC Hydronic Energy Meters	23 00 00	230000 (ATC)	26 00 00 & 230000 (ATC)	230000 (ATC)	N/A	3
Airflow Measuring Stations	230000 (ATC)	230000 (ATC)	N/A	230000 (ATC)	N/A	
DDC Panels	230000 (ATC)	230000 (ATC)	26 00 00 & 230000 (ATC)	230000 (ATC)	N/A	4
VFDs at RTU EFs	230000 (ATC)	230000 (ATC)	26 00 00	230000 (ATC)	N/A	
Elevator Hoistway Vent Damper	23 00 00	23 00 00	N/A	N/A	N/A	

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
Elevator Hoistway Vent Damper Actuator	230000 (ATC)	230000 (ATC)	230000 (ATC)	230000 (ATC)	26 00 00	
Boiler/DHW/Generator Breeching	22 00 00	22 00 00	N/A	N/A	N/A	
Kitchen Emergency Gas Valve	22 00 00	22 00 00	26 00 00	26 00 00	26 00 00	

Notes:

1. Division 23 00 00 and Division 230000 (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 00 to junction box locations shown on electrical drawings; Division 230000 (ATC) Contractor shall provide final power wiring from junction box to end device location.
3. Division 26 00 00 Contractor shall provide all line-voltage power wiring required for meters; Division 23 09 23 Contractor shall provide all low-voltage power wiring required for meters.
4. Division 26 00 00 shall provide power at main DDC Panel. Division 230000 (ATC) shall provide power to all other DDC Panels.

1.30 ALTERNATES

A. None

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 do not indicate what is not acceptable or suitable for a particular location or application. As an example: non-metallic sheathed cable is not specified; therefore, it is not acceptable.

B. For purpose of establishing a standard of quality and not for purpose of limiting competition, the basis of this Specification is upon specified models and types of equipment and materials, as manufactured by specified manufacturers.

C. In all cases, standard cataloged materials and systems have been selected. Materials such as lighting fixtures specially manufactured for this particular project and not part of a manufacturers' standard product line will not be acceptable. In the case of systems, the system components shall be from a single source regularly engaged in supplying such systems. A proposed system made up of a collection of various manufacturers' products will be unacceptable.

D. Where Specifications list manufacturers' names and/or "as approved" or "Equal approved by Architect", other manufacturers' equipment will be considered if equipment meets Specification requirements and has all features of the specified items as are considered essential by Architect.

E. All material shall be new and shall be UL listed.

2.2 RACEWAYS AND FITTINGS

A. Raceways - General:

1. No raceway shall be used smaller than ¾ in. diameter and shall have no more than four 90o 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 80 conduit will be used as indicated on Electrical Site Plan, and as required by code.
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 as required by Code.

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

A. All conductors shall be a minimum size of #12 AWG except for control wiring and fire alarm wiring where #14 AWG may be used. For all exit sign circuits, normal/emergency and/or emergency only circuits, exterior lighting circuits, and also where distance from panelboard to first outlet exceeds 80 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.	480Y/277V	Phase A	Brown
5.	480Y/277V	Phase B	Orange
6.	480Y/277V	Phase C	Yellow
7.	Grounded Conductor		
		120/208	White
		277/480	Grey
8.	Equipment Ground		
		120/208	Green
		277/480	Green with Yellow Trace
9.	Isolated Ground	120/208	Green with Orange Trace

B. All conductors not installed in accordance with color scheme shall be replaced. All conductors larger than #6 AWG must be identified with colored tape.

C. Conductors rated 100Amperes and higher may be Aluminum, unless specifically noted otherwise on the drawings. All conductor and conduit sizing shown on the drawings is done using copper conductors, where the electrical contractor utilizes Aluminum conductors for feeders 100Amperes or higher it is the responsibility of the electrical contractor to convert the feeder size and conduit size to comply with NEC aluminum conductor ampacity based on NEC 310.15(B)(16). Utilize conduit fill tables in the NEC to size conduit for aluminum conductors.

D. Where stranded Aluminum conductors are utilized terminate cable using a compression connector system that is compatible with aluminum conductors for a high quality connection, Utilize Thomas and betts compression connector system or equal. Compression type pigtail adapters are also acceptable.

E. Secondary Service conductors shall be Copper as indicated on the contract documents. Aluminum for the secondary service conductors is not allowed.

F. Comply with CMR 527, Massachusetts Electrical Code.

G. 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.

H. Comply with NEMA WC-5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

I. 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:
4. 3M "Scotchlock"
    a. IDEAL "Wingnut"
    b. BURNDY
    c. MAC
    d. Or equal
5. 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.

J. 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".

K. Stranded conductors for all wiring systems except fire alarm will be allowed if installed and terminated as specified under Execution Section.

L. 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.

M. Type MC Cable may be used for concealed branch circuits 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. Light steel armor is acceptable. Aluminum armor is not acceptable.

N. Fire alarm low energy plenum rated cable is acceptable for fire alarm for concealed locations where allowed by code and not subject to damage.

O. Acceptable manufacturers:

1. AFC Cable Systems
2. Cornish
3. Cresent
4. General Cable
5. Okonite
6. Or equal

P. 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 can not 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'-0" 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. Refer to section 083100 – ACCESS DOORS AND PANELS for requirements, and as follows;

B. Provide access panels for access to concealed junction boxes and to other concealed parts of system that require accessibility for operation and maintenance. In general, electrical work shall be laid out so access panels are not required.

C. 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.

D. Access panels shall be prime painted and equipped with screwdriver operated cam locks.

E. Acceptable manufacturers:

Inland Steel Products Company - Milcor

Miami Carey

Walsh – Hannon- Gladwin, Inc. – Way Locator

Or Equal

Specific types:

1. Acoustical Tile Ceiling "Milcor Type AT"
2. Plastered Surfaces "Milcor Type K"
3. Masonry Construction "Milcor Type M"

4. Drywall Construction "Milcor Type DW"

F. Furnish access panel shop drawings.

2.5 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 Contractor so he may box out opening in form work.

D. Sleeves or openings through slabs for passage of future cables shall be located within 6 inches of walls and shall be in a single row and shall be proofed whether used or not.

E. Any openings through fire rated surfaces shall be closed off with fireproofing materials providing the same rating as the surface penetrated.

1. Acceptable Manufacturers:
Specified Technologies Inc.
Thomas & Betts
International Protective Coatings Corp.
3M Fire Protection Products
Dow Corning
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. FB6-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.

G. 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
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” 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” 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” 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.

H. 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

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" [419mm].

1) Insert: Insert body shall have the necessary channels to provide complete separation of power and communication services. There shall be one (1) 3/4-inch trade size channel for power and two (2) 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 (2) 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 (1) 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 (3) 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 (7) 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 (1) 3/4-inch NPSM threaded opening for power and two (2) 1/2-inch NPSM threaded openings for communication to feed modular furniture workstations. Each activation cover shall also be supplied with one (1) 3/4-inch trade size and two (2) 1/2-inch trade size threaded conduit connectors and one (1) 3/4-inch trade size and one (1) 3/4-inch trade size and two (2) 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 (1) 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" - 2" trade size conduit opening and closure plugs. The trim flange shall be seven (7) inches [178mm] in diameter. All power connections must be made in a junction box below (not supplied).

I. 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.

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'-6" 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.

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.

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. Controlled Receptacles:

1. Leviton 5362 – S1 (one controlled outlet)
2. Leviton 5362-S2 (two controlled outlet)
3. Pass & Seymour 5362-CH (one controlled outlet)
4. Pass & Seymour 5362-CD (two controlled outlet)
5. Arrowhart 5362-CH (one controlled outlet)
6. Arrowhart 5362-CD (two controlled outlet)
7. Hubbell BR20C1 (one controlled outlet)
8. Hubbell BR20C2 (two controlled outlet)

H. 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° 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

I. 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).

J. Securely fasten wiring devices in place, plumb, level, and true to finished lines and surfaces.

K. 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.

L. Provide gaskets on all wiring device plates where devices are on walls separating conditioned and non-conditioned spaces and exterior walls.

M. 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, outlets in auditorium shall be brown.

N. 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: Satin-finished Type 302 stainless steel.
    c. Material for Unfinished Spaces: Galvanized steel.
    d. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
    e. Material for Auditorium Locations: Satin bronze.
2. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum.

O. Finishes:

1. Color: Wiring device catalog numbers as specified do not designate device color.
    a. Wiring Devices Connected to Normal Power System: 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.
5. Lighting fixture package submittals shall be fully coordinated between the electrical contractor, lighting fixture representative(s), and lighting manufacturers to ensure all product, installation, and control requirements are met prior to submission for review. It is the electrical contractors responsibility to provide a package meeting all requirements of the project for a complete and fully functional lighting system.

C. Lamps

1. Furnish lamps that comply with requirements specified below and the luminaire schedule on the Drawings.
2. Compact fluorescent lamps shall have kelvin color temperature as scheduled with a color rendering index of 82 minimum. Compact fluorescent lamps shall be the amalgam type, Sylvania Dulux T/E/IN or equal by Philips, GE, or equal.
3. Linear fluorescent lamps shall have kelvin color temperature as scheduled with a color rendering index of 85 minimum. T5ho lamps shall be the energy saver type, Sylvania Pentron HO Supersaver Ecologic or equal by Philips, GE, or equal. All T5 lamps shall be the energy saver type, Sylvania Pentron Supersaver Ecologic or equal by Philips, GE, or equal.

D. Ballasts

1. Standard compact fluorescent ballasts shall be Sylvania Quicktronic Prostart CF series or equal by Advance, GE, Universal, or equal.
2. Dimming compact fluorescent ballasts shall be Sylvania Quicktronic Helios CF series (0-10v) or equal by Advance, GE, Lutron, or equal.
3. Standard T5 and T5HO linear fluorescent ballasts shall be high efficiency type, Sylvania QHE Prostart series or equal by Advance, GE, Universal, or equal.
4. Dimming linear fluorescent ballasts (0-10v) shall be Sylvania Quicktronic Powersense (T5) series or Sylvania Quicktronic Helios (T5HO) series or equal by Advance, GE, Lutron, or equal.
5. Three and four lamp luminaires shall have two ballasts per luminaire for multilevel switching.
6. Provide NRTL-listed luminaire disconnect assembly for each ballast.

E. 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.

F. Extra Materials
1. Furnish the following extra materials matching products installed. Package with protective covering for storage and identify with labels describing contents.
    a. Provide one extra fixture of each fixture specified and turn over to the Owner as attic stock.

G. Interior General:
1. Furnish interior luminaries that comply with requirements specified below, indicated on the Drawings, and to meet conditions of each specific 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 inches minimum thickness. Lenses for fluorescent troffers shall be injection molded.

8. Luminaires shall conform to UL 1598 - *Luminaires*. Provide product with damp location listing or wet location listing as indicated on the Drawings, and to meet conditions of each specific installation.

H. Interior Accessories

1. Provide stud supports, mounting brackets, frames, plaster rings and other accessories required for luminaire installation.
2. Furnish hangers as specified below, indicated on the Drawings, and to meet conditions of each specific 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 fluorescent luminaires.
4. Where indicated on the Drawings or where lamp breakage is detrimental, such as above food counters, provide fluorescent luminaires with:
    a. Self-locking sockets or lamp retainers, two per lamp, and
    b. Clear glass, acrylic, or polycarbonate lens over each fixture aperture. Lenses shall have a light transmission of 95 percent and shall be rated for the thermal profile of the lamp and ballast.

I. 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 selected and sized to span obstacles
    c. Secure wire(s) at each end with not less than three tight turns in 1-1/2 inches.
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 inches of differential seismic movement in any direction.

J. 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. Burn-in dimmer controlled fluorescent lamps at full output for not less than 100 hours before dimming.
    b. 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.

2.9 LIGHTING CONTROLS

A. Manufacturer

1. Lutron VIVE (or equal)

B. Section Includes

1. Single space wireless lighting control systems and associated components:
2. Wireless occupancy/vacancy sensors.
3. Wireless daylight sensors.
4. Wired load control modules with wireless communication inputs.
5. Includes fixture control modules with wired occupancy/vacancy/daylight sensors.
6. Wired receptacles with wireless communication inputs.
7. Wireless fixture control components factory-installed in luminaires not specified in this section.
8. Wired wall dimmers and switches with wireless communication inputs.
9. Wired wallbox occupancy sensors with wireless communication inputs.
10. Wireless control stations.
11. Power interfaces.
12. Digital dimming ballast modules.
13. Wireless hub(s) for centralized control, monitoring, and system integration.
14. Software data and analytics dashboard, including server requirements.

C. ADMINISTRATIVE REQUIREMENTS

1. Coordination:
2. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
3. Coordinate the placement of wall controls with actual installed door swings.

4. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
7. Sequencing:
    a. Do not install sensors and wall controls until final surface finishes<< and painting>> are complete.

D. Submittals;

1. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.
2. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
3. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.
4. Wall Dimmers: Include derating information for ganged multiple devices.
5. Wall Controls:
    a. Show available color and finish selections.
6. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. QUALITY ASSURANCE

1. Conform to requirements of NFPA 70.
2. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
3. Manufacturer Qualifications:
    a. Company with not less than ten years of experience manufacturing lighting control products using wireless communication between devices.
    b. Registered to ISO 9001, including in-house engineering for product design activities.
    c. If there is a problem on the job site, the manufacturer must be reachable 24 hours per day, 7 days per week to resolve any lighting control issues. If this service is not provided, project cost overruns and delays can occur. Additionally, answering services can add to frustration and delays.
    d. Provides factory direct technical support hotline available 24 hours per day, 7 days per week.
    e. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

F. LIGHTING CONTROLS - GENERAL REQUIREMENTS

1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.
2. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, programming, etc. as necessary for a complete operating system that provides the control intent indicated.
3. Typical dimming equipment is rated for 40 degrees C (104 degrees F). This is the maximum ambient temperature that can exist while the dimming equipment is operating at full load conditions. Include the following paragraph to ensure that the operating equipment is designed to operate at worst case environmental conditions without affecting product life.
4. Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.
5. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
6. Power dropouts occur frequently. The momentary interruption of power should not cause extended periods without lighting or require some manual intervention to reset the lighting system. Some manufacturers may define power failure memory as a feature that handles momentary power outages on the order of 20 seconds. This does not account for power outages that occur for a longer period of time.

G. Wireless Devices:

1. Wireless device family includes area or fixture level sensors, area or fixture level load controls for dimming or switching, and load controls that can be mounted in a wallbox, on a junction box, or at the fixture.
2. Wireless devices including sensors, load controls, and wireless remotes or wall stations, can be set up using simple button press programming without needing any other equipment (e.g. central hub, processor, computer, or other smart device).
3. Wireless hub adds the ability to set up the system using any smart device with a web browser (e.g. smartphone, tablet, PC, or laptop).
4. System does not require a factory technician to set up or program the system.
5. Capable of diagnosing system communications.
6. Capable of having addresses automatically assigned to them.
7. Receives signals from other wireless devices and provides feedback to user.
8. Capable of determining which devices have been addressed.
9. RF Range: 60 feet (18 m) line-of-sight or 30 feet (9 m) through typical construction materials between RF transmitting devices and compatible RF receiving devices.
10. The FCC sets limits on EMI/RFI for both non-consumer (commercial and industrial) and consumer (residential) applications. The class B, consumer limits are more stringent than the class A, non-consumer limits.
11. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 15, for Class B application.

H. Wireless Network:

1. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
2. Wireless sensors, wireless wall stations and wireless load control devices do not operate in the noisy 2.4 GHz frequency band where high potential for RF interference exists.
3. Wireless devices operate in an uncongested frequency band providing reliable operation.
4. Fixed network architecture ensures all associated lights and load controls respond in a simultaneous and coordinated fashion from a button press, sensor signal, or command from the wireless hub (i.e. no popcorning).
5. Distributed Architecture: Local room devices communicate directly with each other. If the wireless hub is removed or damaged, local control, sensing, and operation continues to function without interruption.
6. Local room devices communicate directly with each other (and not through a central hub or processor) to ensure:
7. Reliability of system performance.
8. Fast response time to events in the space (e.g. button presses or sensor signals).
9. Independent operation in the event of the wireless hub being removed or damaged.

I. Device finishes

1. Coordinate finishes with architect. Provide available finishes in the submittal for architect to select.

J. WIRELESS SENSORS

1. General Requirements:
    a. Operational life of 10 years without the need to replace batteries when installed per manufacturer's instructions.
    b. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
    c. Does not require external power packs, power wiring, or communication wiring.
    d. Capable of being placed in test mode to verify correct operation from the face of the unit.

K. Wireless Occupancy/Vacancy Sensors:

1. General Requirements:
    a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
    b. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
    c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
    d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.

e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.

f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1 percent to 100 percent.

g. Color: White.

h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.

i. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.

j. Sensor lens to illuminate during test mode when motion is detected to allow installer to place sensor in ideal location and to verify coverage prior to permanent mounting.

k. Ceiling-Mounted Sensors:
   1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
   2) Provide recessed mounting bracket compatible with drywall and compressed fiber ceilings.

l. Wall-Mounted Sensors: Provide wall or corner mounting brackets compatible with drywall and plaster walls.

2. Wireless Combination Occupancy/Vacancy Sensors:

   a. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).

   b. Wall-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), or a vacancy sensor (manual-on and automatic-off).

3. Products:

   a. Ceiling-Mounted Occupancy/Vacancy Sensor; Lutron Radio Powr Savr Series, Model LFR2-OCR2B-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OCR2B-P-WH: Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.

   b. Wall-Mounted Occupancy/Vacancy Sensor; Lutron Radio Powr Savr Series, Model LFR2-OWLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OWLB-P-WH : Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 180 degree field of view.

   c. Corner-Mounted Occupancy/Vacancy Sensor; <Lutron Radio Powr Savr Series, Model LFR2-OKLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OKLB-P-WH Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 90 degree field of view.

d. Hallway Occupancy/Vacancy Sensor; Lutron Radio Powr Savr Series, Model LFR2-OHLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OHLB-P-WH (BAA-BuMajor motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view.

e. Wireless Daylight Sensors:
   1) Product: Lutron Radio Powr Savr Series, Model LFR2-DCRB-WH.
   2) Open-loop basis for daylight sensor control scheme.
   3) Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).
   4) Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
   5) Provide linear response from 2 to 150 footcandles.
   6) Color: White.
   7) Mounting:
      a) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
      b) Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
      c) Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.

L. LOAD CONTROL MODULES

1. Provide wireless load control modules as indicated or as required to control the loads as indicated.

2. Junction Box-Mounted Modules:

   a. Plenum rated.

   b. 0-10 V Dimming Modules:
      1) Products
         a) 8 A dimming module with 0-10V control, without emergency lighting mode; Lutron PowPak Dimming Module Model RMJS-8T-DV-B; or Lutron PowPak Dimming Module Model URMJS-8T-DV-B
         b) 8 A dimming module with 0-10V control, with emergency lighting mode; Lutron PowPak Dimming Module Model RMJS-8T-DV-B-EM.
      2) Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
      3) IEC 60929 is a standard for electronic fluorescent ballasts, and is used by other lighting equipment controlled by low voltage signals including LED drivers and low voltage controlled neon. It defines specific methods for 0-10V, pulse width modulation (PWM), and Digitally Addressable Lighting Interface (DALI).
      4) Single low voltage dimming module with Class 1 or Class 2 isolated 0-10V output signal conforming to IEC 60929 Annex E.2; source or sink automatically configures.
      5) Selectable minimum light level.
      6) Configurable high- and low-end trim.
      7) Relay: Rated for 0-10 V ballasts, LED drivers, or fixtures that conform with NEMA 410.

8) Dimming Modules with Emergency Lighting Mode:
   a) Operation With *Lutron Vive* Wireless Hub: Upon loss of power, dimming module enters and remains in emergency lighting mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, dimming module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
   b) Operation Without *Lutron Vive* Wireless Hub: Upon loss of power, dimming module enters and remains in emergency lighting mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.
   c) UL 924 listed.

3. Digital Ballast/LED Driver Dimming Modules:

   a. Product: Lutron PowPak Single Zone Control Module with EcoSystem; Model RMJS-ECO32-SZ.

   b. Single dimming module with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct control without interface.

   c. Provides direct low-voltage control of up to 32 compatible Lutron EcoSystem and third party DALI digital ballasts/LED drivers as a single zone (multiple ballasts/LED drivers connected to same module will be at same light level).
      1) Electronically links a digital ballast/LED driver to a zone for both dimming and turning on/off.
      2) Electronically assigns occupancy/vacancy sensors for manual on/auto off and auto on/auto off control.
      3) Electronically assigns wireless control stations for manual local control.
      4) Electronically assigns daylight sensor for automatic daylight dimming.

   d. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.

   e. Selectable minimum light level.

   f. Configurable high- and low-end trim.

4. Relay Modules:

   a. Products:
      1) 16 A relay module, without emergency lighting mode, without contact closure output; << Lutron PowPak Relay Module Model RMJS-16R-DV-B; or Lutron PowPak Relay Module Model URMJS-16R-DV-B (BAA-Buy American Act Compliant)>>.
      2) 16 A relay module, with emergency lighting mode, without contact closure output; Lutron PowPak Relay Module Model RMJS-16R-DV-B-EM.
      3) 16 A relay module, without emergency lighting mode, with contact closure output; << Lutron PowPak Relay Module Model RMJS-16RCCO1-DV-B; or Lutron PowPak Relay Module Model URMJS-16RCCO1-DV-B (BAA-Buy American Act Compliant)>>.
      4) 5 A relay module, without emergency lighting mode, without contact closure output; Lutron PowPak Relay Module Model RMJS-5R-DV-B.
      5) 5 A relay module, without emergency lighting mode, with contact closure output; Lutron PowPak Relay Module Model RMJS-5RCCO1-DV-B.

   b. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.

c. Relay:
   1) Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   2) Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   3) Fully rated output continuous duty for inductive, capacitive, and resistive loads.

d. Contact Closure Output:
   1) Single contact closure output with normally open and normally closed dry maintained contacts suitable for connection to third party equipment (e.g. building management system, HVAC system, etc.).
   2) Contact Ratings: Resistive load; 1 A at 0-24 VDC, 0.5 A at 0-24 VAC.
   3) Controlled by associated occupancy/vacancy sensors and wall controls.

e. Relay Modules With Emergency Lighting Mode:
   1) Operation With Lutron Vive Wireless Hub: Upon loss of power, relay module enters and remains in emergency lighting mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, relay module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
   2) Operation Without Lutron Vive Wireless Hub: Upon loss of power, relay module enters and remains in emergency lighting mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.
   3) UL 924 listed.

5. Contact Closure Output Modules:

   a. Product: << Lutron PowPak CCO Module Model RMJS-CCO1-24-B; or Lutron PowPak CCO Module Model URMJS-CCO1-24-B (BAA-Buy American Act Compliant)>>.

   b. Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.

   c. Contact Closure Output:
      1) Single contact closure output with normally open and normally closed dry maintained contacts suitable for connection to third party equipment (e.g. building management system, HVAC system, etc.).
      2) Contact Ratings: Resistive load; 1 A at 0-24 VDC, 0.5 A at 0-24 VAC.
      3) Operation affected by associated occupancy/vacancy sensors and wall controls.

6. Fixture Control Modules/Sensors:

   a. Fixture Control Modules:
      1) Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
      2) Communicates via wired input with one combination occupancy/daylight or vacancy/daylight fixture sensor.
      3) Coordination between Wired and Wireless Sensors:
         a) Occupancy/Vacancy Sensing: Wired and wireless sensors work in conjunction (occupancy detected by either sensor turns lights on and vacancy detected by both sensors turns lights off).
         b) Daylight Sensing: Wireless sensor takes precedence over wired sensor.
      4) Certain applications, such as hallways, may require that the lights never turn off. For these areas, select the minimum light level option and the load will lower to programmed low-end level. Default operation lowers to OFF.

5) Selectable minimum light level.
6) Configurable high- and low-end trim.
7) Plenum rated.
8) Mounts to fixture or junction box through ½ inch (16 mm) trade size knockout.
9) Digital Ballast/LED Driver Fixture Control Modules:
10) Product(s):
    a) Digital ballast/LED driver fixture control module, without emergency lighting mode; Lutron PowPak Wireless Fixture Control for EcoSystem ballasts/drivers; Model FCJS-ECO.
    b) Digital ballast/LED driver fixture control module, with emergency lighting mode; Lutron PowPak Wireless Fixture Control for EcoSystem ballasts/drivers; Model FCJS-ECO-EM.
11) Supports reporting of energy measurement to wireless hub at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).
12) IEC 60929 is a standard for electronic fluorescent ballasts, and is used by other lighting equipment controlled by low voltage signals including LED drivers and low voltage controlled neon. It defines a specific method for digital control.
13) Single integral controller with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct control without interface.
14) Provides direct low-voltage control of up to 3 compatible digital ballasts/LED drivers.
    a) Electronically links a digital ballast/LED driver to a zone for both dimming and turning on/off.
    b) Electronically assigns occupancy/vacancy sensors for manual on/auto off and auto on/auto off control.
    c) Electronically assigns wireless control stations for manual local control.
    d) Electronically assigns daylight sensor for automatic daylight dimming.
15) Fixture Control Modules With Emergency Lighting Mode:
    a) Operation With Lutron Vive Wireless Hub: Upon loss of power, fixture control module enters and remains in emergency lighting mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, fixture control module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
    b) Operation Without Lutron Vive Wireless Hub: Upon loss of power, fixture control module enters and remains in emergency lighting mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.
    c) UL 924 listed.

7. 0-10 V Dimming Fixture Control Modules:

    a. Product(s):
        1) 0-10 V dimming fixture control module, without emergency lighting mode; Lutron PowPak Wireless Fixture Control for 0-10 V ballasts/drivers; Model FCJS-010.
        2) 0-10 V dimming fixture control module, with emergency lighting mode; Lutron PowPak Wireless Fixture Control for 0-10 V ballasts/drivers; Model FCJS-010-EM.

    b. Supports reporting of energy measurement to wireless hub at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).

c. IEC 60929 is a standard for electronic fluorescent ballasts, and is used by other lighting equipment controlled by low voltage signals including LED drivers and low voltage controlled neon. It defines specific methods for 0-10V, pulse width modulation (PWM), and Digitally Addressable Lighting Interface (DALI).

d. Single low voltage dimming module with Class 1 or Class 2 isolated 0-10V output signal conforming to IEC 60929 Annex E.2; source or sink automatically configures.

e. Provides 0-10 V control for up to 3 ballasts/LED drivers (1 A load at 120-277 V, 6 mA max control current).

f. Rated for switching 0-10 V ballasts, LED drivers, or fixtures that conform with NEMA 410.

g. Fixture Control Modules With Emergency Lighting Mode:
   1) Operation With Lutron Vive Wireless Hub: Upon loss of power, fixture control module enters and remains in emergency lighting mode as long as wireless hub is de-energized; upon restoration of power to wireless hub, fixture control module returns to normal mode and lights automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
   2) Operation Without Lutron Vive Wireless Hub: Upon loss of power, fixture control module enters and remains in emergency lighting mode for 90 minutes, during which time local unit buttons and wireless controls are disabled.
   3) UL 924 listed.

8. Wired Fixture Sensors:

a. Product(s):
   1) Wired occupancy/daylight fixture sensor; Lutron PowPak Fixture Sensor; Model FC-SENSOR.
   2) Wired vacancy/daylight fixture sensor; Lutron PowPak Fixture Sensor; Model FC-VSENSOR.

b. Occupancy/Vacancy Sensing:
   1) Lutron's XCT signal processing technology greatly enhances the performance of PIR sensors, enabling them to "see" fine motions that other sensors couldn't previously detect.
   2) Coverage: 300 square feet (28 sq m) with mounting height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.
   3) Sensor Timeout: 15 minutes.
      a) Sensor timeout adjustable via Lutron Vive wireless hub when connected to compatible fixture control module.

c. Daylight Sensing:
   1) Automatic calibration.
   2) Provide linear response to changes in perceived light level.
      a) Response adjustable via Lutron Vive wireless hub when connected to compatible fixture control module.
   3) Closed loop proportional control scheme.
   4) Sensor Range: 0 to 150 footcandles (0 to 1600 lux).

d. Mounts to fixture or ceiling.

9. WIRED WALL DIMMERS AND SWITCHES WITH WIRELESS COMMUNICATION INPUTS

a. General Requirements:
   1) Provide air gap service switch to disconnect power to load for safe lamp replacement, accessible without removing faceplate.
   2) Operates at the rated capacity across the full ambient temperature range including modified capacities for ganged configurations which require removal of fins.
   3) Provide radio frequency interference suppression.
   4) Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
   5) Dimmers: Provide full range, continuously variable control of light intensity.
   6) Dimmers for Electronic Low Voltage (ELV) Transformers:
      a) Provide circuitry designed to control the input of electronic (solid-state) low voltage (ELV) transformers. Do not use dimmers that utilize standard phase control.
      b) Provide resettable overload protection that provides automatic shut-off when dimmer capacity is exceeded. Do not use protection methods that are non-resettable or require device to be removed from outlet box.
      c) Designed to withstand a short, per UL 1472, between load hot and either neutral or ground without damage to dimmer.
   7) Dimmers for Magnetic Low Voltage (MLV) Transformers:
      a) Provide circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.
      b) Magnetic low voltage transformers to operate below rated current or temperature.
   8) Electronic Switches:
      a) Listed as complying with UL 20, UL 508, and UL 1472.
   9) Preset Smart Wall Dimmers and Switches with Wireless Communication Inputs; Lutron Maestro Wireless Series:
      a) Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
      b) Dimmer Control: Multi-function tap switch with small, raised rocker for dimmer adjustment.
      c) Rocker raises/lowers light level, with new level becoming the current preset level.
      d) Switch single tap raises lights to preset level or fades lights to off.
      e) Switch double tap raises light to full on level.
      f) Switch tap and hold slowly fades lights to off over period of 10 seconds.
      g) LEDs adjacent to tap switch indicate light level when dimmer is on, and function as locator light when dimmer is off.
   10) Switch Control: Switch single tap turns lights on/off.
   11) Dimmer High End Trim:
      a) Incandescent Dimmers: Minimum of 92 percent of line voltage.
      b) Dimmers for Electronic Low Voltage (ELV) Transformers: Minimum of 95 percent of line voltage.
      c) Dimmers for Magnetic Low Voltage Transformers: Minimum of 92 percent of line voltage.

12) Products - Preset Smart Dimmers with Wireless Communication Inputs:
    a) Preset Smart Dimmer; Lutron Maestro Wireless Series: Incandescent/halogen (600 W, 120 V), magnetic low voltage (600 VA/450 W, 120 V), dimmable CFL/LED (150 W, 120 V); multi-location capability using companion dimmers (up to nine companion dimmers may be connected); minimum load requirement.
    b) Lutron Model MRF2S-6CL; single pole/multi-location; 120 V.
    c) Preset Smart Dimmer; Lutron Maestro Wireless Series: Electronic low voltage (600 W, 120 V); neutral required; multi-location capability using companion dimmers (up to nine companion dimmers may be connected); minimum load requirement.
    d) Lutron Model MRF2S-6ELV-120; single-pole/multi-location; 120 V.
    e) Preset Smart Dimmer; Lutron Maestro Wireless Series: Incandescent (600 W, 120 V), magnetic low voltage (600 VA/450 W, 120 V); neutral required; multi-location capability using companion dimmers (up to nine companion dimmers may be connected); minimum load requirement.
    f) Lutron Model MRF2S-6ND-120; or Lutron Model UMRF2S-6ND-120 (BAA-Buy American Act Compliant)>>; single-pole/multi-location; 120 V.
13) Products - Electronic Switches with Wireless Communication Inputs:
    a) Electronic Switch; Lutron Maestro Wireless Series: 6 A lighting/3 A fan (120 V); neutral required; multi-location capability using companion switches (up to nine companion switches may be connected); minimum load requirement.
    b) Lutron Model MRF2S-6ANS; single-pole/multi-location; 120 V.
    c) Electronic Switch; Lutron Maestro Wireless Series: 8 A lighting/5.8 A fan (120 V); neutral required; multi-location capability using companion switches (up to nine companion switches may be connected); minimum load requirement.
    d) Lutron Model MRF2S-8ANS-120; or Lutron Model UMRF2S-8ANS-120 (BAA-Buy American Act Compliant)>>; single-pole/multi-location; 120 V.
    e) Electronic Switch; Lutron Maestro Wireless Series: 8 A lighting/3 A fan (120 V); 8 A lighting (277 V); multi-location capability using companion switches (up to nine companion switches may be connected); minimum load requirement.
    f) Lutron Model MRF2S-8S-DV; or Lutron Model UMRF2S-8S-DV (BAA-Buy American Act Compliant)>>; single-pole/multi-location; 120-277 V.

10. WIRED WALLBOX OCCUPANCY SENSORS WITH WIRELESS COMMUNICATION INPUTS

    a. 0-10 V Wall Dimmer/Switch Combination Occupancy/Vacancy Sensors with Wireless Communication Inputs; Lutron Maestro Wireless 0-10 Dimmer Sensor/Maestro Wireless Sensor Switch Series:
        1) Communicates via radio frequency with up to ten compatible wireless occupancy/vacancy sensors, ten wireless control stations, and one wireless daylight sensor.
        2) Compatible with sourcing electronic 0-10 V ballasts/drivers, as per IEC 60929 Annex E.2 0-10 V protocol.
        3) Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be selectable as either adaptive utilizing occupant feedback (Lutron Smart Ambient Light Detection) or as fixed (high, medium, low, and minimum presets).

4) Occupancy/Vacancy Sensors:
   a) Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b) Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
   c) Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
   d) Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area; adjustable timeout settings (1, 5, 15, or 30 minutes).
   e) Adjustable sensitivity (high, medium, low, and minimum presets).
   f) Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; when room is vacated, returns to normal automatic-on operation after time delay period.
   g) Selectable walk-through mode to override selected timeout and automatically turn off lights if no motion is detected within 3 minutes after initial occupancy for applications where space may be briefly occupied.
5) Dimmer Features:
   a) Adjustable high/low end trims.
   b) Selectable dimming curve (linear or switched).
   c) Selectable fade on/fade off times (15, 5, 2.5, or 0.75 sec).
   d) Adjustable auto-on light level (fully adjustable from one to 100 percent).
6) Dimmer Control: Multi-function tap switch with small, raised rocker for dimmer adjustment.
   a) Rocker raises/lowers light level, with new level becoming the current preset level.
   b) Switch single tap raises lights to preset level or fades lights to off.
   c) Switch double tap raises light to full on level.
7) Switch Control: Switch single tap turns lights on/off.
8) Products:
   a) Passive Infrared 0-10 V Wall Dimmer Occupancy/Vacancy Sensor; Lutron Maestro Wireless 0-10 V Dimmer Sensor/Maestro Wireless Sensor Switch Series: 0-10 V control for 0-10 V fluorescent ballasts/LED drivers (8 A load at 120-277 V, 50 mA max control current); coverage of 900 square feet (81 sq m) with mounting height of 4 feet (1.2 m); 180 degree field of view; multi-location capability using Pico wireless control stations with wallbox mounting adapter.
   b) Sensor dimmer; occupancy/vacancy; Lutron Model MRF2S-8SD010.
   c) Sensor dimmer; vacancy-only; Lutron Model MRF2S-8SDV010.
   d) Sensor switch; occupancy/vacancy; Lutron Model MRF2S-8SS.
   e) Sensor switch; vacancy-only; Lutron Model MRF2S-8SSV.

11. WIRELESS CONTROL STATIONS

a. Products:
   1) 2-Button Control; <<Lutron Pico Wireless Control Model PJ2-2B; or Lutron Pico Wireless Control Module UPJ2-2B (BAA-Buy American Act Compliant)>>.
      a) Button Marking: Light (icons); As indicated on drawings.
   2) 2-Button Control with Night Light; Lutron Pico Wireless Control Model PJN-2B.

3) 2-Button with Raise/Lower Control; <<Lutron Pico Wireless Control Model PJ2-2BRL; or Lutron Pico Wireless Control Module UPJ2-2BRL (BAA-Buy American Act Compliant)>>.
   a) Button Marking: Light (icons); As indicated on drawings; or.
4) 3-Button Control; Lutron Pico Wireless Control Model PJ2-3B; or Lutron Pico Wireless Control Module UPJ2-3B (BAA-Buy American Act Compliant).
   a) Button Marking: Light (icons); As indicated on drawings.
5) 3-Button with Raise/Lower Control; Lutron Pico Wireless Control Model PJ2-3BRL; or Lutron Pico Wireless Control Module UPJ2-3BRL (BAA-Buy American Act Compliant).
   a) Button Marking: Light (icons); As indicated on drawings.
6) 3-Button with Raise/Lower Control and Night Light; Lutron Pico Wireless Control Model PJN-3BRL.
7) 4-Button; Lutron Pico Wireless Control Model PJ2-4B; or Lutron Pico Wireless Control Module UPJ2-4B (BAA-Buy American Act Compliant).
   a) Button Marking: Zone controls (light); Scene keypads (light); 2-group controllers (lights); 4-group toggle; As indicated on drawings.
8) Single Pedestal; Lutron Pico Pedestal Model L-PED1.
9) Double Pedestal; Lutron Pico Pedestal Model L-PED2.
10) Triple Pedestal; Lutron Pico Pedestal Model L-PED3.
11) Quadruple Pedestal; Lutron Pico Pedestal Model L-PED4.
12) Screw Mounting Kit; Lutron Model PICO-SM-KIT.
13) Wallbox Adapter; Lutron Model PICO-WBX-ADAPT.

b. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.

c. Does not require external power packs, power or communication wiring.

d. Controls can be programmed with different functionality through system software without any hardware changes.

e. Allows for easy reprogramming without replacing unit.

f. Button Programming:
   1) Single action.
   2) Toggle action.

g. Includes LED to indicate button press or programming mode status.

h. Mounting:
   1) Capable of being mounted with a table stand or directly to a wall under a faceplate.
   2) Faceplates: Provide concealed mounting hardware.

i. Power: Battery-operated with minimum ten-year battery life (3-year battery life for night light models).

j. Finish: White; Black; Ivory; Light Almond; White/Grey; To be selected by Architect.

12. POWER INTERFACES

a. Provide power interfaces as indicated or as required to control the loads as indicated.

b. General Requirements:
   1) Phase independent of control input.
   2) Dimmer to meet limited short circuit test as defined in UL 508.
   3) Utilize air gap off to disconnect the load from line supply.
   4) Diagnostics and Service: Replacing power interface does not require re-programming of system or processor.

c. Product(s):
   1) Phase-Adaptive Power Module; Lutron PHPM-PA: Provides interface for phase control input to provide full 16 A circuit output of forward/reverse phase control for compatible loads.
   2) 3-Wire Fluorescent Power Module; Lutron PHPM-3F: Provides interface for phase control input to provide full 16 A circuit output for compatible line-voltage control fluorescent electronic dimming ballasts or LED drivers.
   3) Switching Power Module; Lutron PHPM-SW: Provides interface for phase control or switched input to provide full 16 A circuit output of switching for compatible non-dim loads.
   4) Ten Volt Interface; Lutron GRX-TVI: Provides interface for phase control input to provide full 16 A circuit output of switching and 0-10 V low voltage control for compatible fluorescent electronic dimming ballasts or LED drivers.

13. WIRELESS HUBS

a. Product(s):
   1) Wireless hub with BACnet; Lutron Vive Premium Hub.
      a) Flush-mount wireless hub; Model HJS-2-FM; supports up to 700 total paired devices.
      b) Surface-mount wireless hub; Model HJS-2-SM; supports up to 700 total paired devices.

b. Integrated multicolor LED provides feedback on what mode the hub is in for simple identification and diagnosis.

c. Integrated processor and web server allows hub to set up and operate the system without any external connections to outside processors, servers, or the internet.

d. Utilizes Ethernet connection for:
   1) Networking up to 64 hubs together to create a larger system.
   2) Integration with Building Management System (BMS) via native BACnet; does not require interface (Lutron Vive Premium wireless hub with BACnet only).
   3) Remote connectivity capabilities, including maintaining system date/time and receiving periodic firmware updates (requires internet connection).

e. A single hub or network of hubs can operate on either a dedicated lighting control only network or can be integrated with an existing building network as a VLAN.

f. Communicates directly to compatible Lutron Vive RF devices through use Lutron Clear Connect radio frequency communications link; does not require communication wiring; RF range of 71 feet (23 m) through walls to cover an area of 15836 square feet (1471 sq m) (device and hub must be on the same floor).

g. Communicates directly to mobile device (smartphone or tablet) or computer using built-in Wi-Fi, 2.4 GHz 802.11b/g; wireless range of 71 feet (23 m) through walls (device and hub must be on the same floor).
   1) Does not require external Wi-Fi router for connecting to the hub.

h. Allows for system setup, control, and monitoring from mobile device or computer using Vive web-based software:
   1) Supports paired devices up to maximum number indicated including compatible wireless sensors, wireless control stations, and wireless load devices.
   2) Allows for timeclock scheduling of events, both time of day and astronomic (sunrise and sunset).
      a) Timeclock is integrated into the unit and does not require a constant internet connection.

b) Retains time and programming information after a power loss.
c) 365-day schedulable timeclock allows for:
d) Scheduling of events years in advance.
e) Setting of recurring events with exceptions on holidays.
f) Time clock events can be scheduled to:
g) Send lights to a desired level and select the fade rate desired to reach that level.
h) Adjust level lights go to when occupied.
i) Adjust level lights go to when unoccupied.
j) Enable/disable occupancy.
k) Adjust timeout of sensors (requires Model FC-SENSOR wired fixture sensor or Model DFCSJ-OEM-OCC wireless fixture control dongle with integral sensing capabilities).
l) Control individual devices, areas, or groups of areas. When connected to Vive Vue server, only areas or groups of areas can be controlled with timeclock events.

3) Daylighting:
   a) Daylighting can be enabled/disabled. Can be used to override the control currently taking place in the space.
   b) The following is particularly useful when new departments move into a space.
4) Allows for control, monitoring, and adjustment from anywhere in the world (Lutron Vive wireless hub internet connection required).
5) Uses RF signal strength detection to find nearby devices for quick association and programming without having to climb ladders.
   a) Association and setup does not require a factory technician to perform.
6) System using Lutron Vive wireless hub(s) can operate with or without connection to the internet.
7) Supports energy reporting.
   a) Reports measured energy data for PowPak fixture control modules at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).
   b) Reports calculated energy data for PowPak junction box mounted modules at accuracy of 10 percent.
   c) Reports measured energy for DFCSJ Series wireless fixture control dongle when paired with driver that supports measured power (measurement accuracy defined by driver specification) or reports calculated power if driver does not have measurement capabilities.
8) Supports automatic demand response for load shedding via:
   a) Local contact closure without need for separate interface.
   b) OpenADR® 2.0b compliant utility command.
   c) BACnet (Lutron Vive Premium wireless hub with BACnet only).
9) Support automatic generation of alerts in Lutron Vive web-based application for designated events/triggers, including:
   a) Low-battery condition in battery-operated sensors and controls; alert cleared when battery is replaced.
   b) Missing device (e.g., control or sensor); alert cleared when device is detected by system.
10) Wireless hub can be firmware upgraded to provide new software features and system updates.
   a) Firmware update can be done either locally using a wired Ethernet connection or Wi-Fi connection, or remotely if the wireless hub is connected to the internet.

i. Lutron Vive Web-Based Application:
   1) Accessibility and Platform Support:
      a) Web-based; runs on most HTML5 compatible browsers (including Safari and Chrome).
      b) Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone.
      c) User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
      d) Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
      e) Multi-level Password Protected Access: Individual password protection on both the integrated Wi-Fi network and web-based software.
      f) WPA2 security for Wi-Fi communication with wireless hub.
   2) System Navigation and Status Reporting:
      a) Area Tree View: Easy navigation by area name to view status and make programing adjustments through the software.
      b) Area and device names can be changed in real time.
   3) Setup app available for iOS and Android that allows for:
      a) Job registration to extend product warranty.
      b) Management of setup for multiple projects in different locations.
      c) Creation of handoff documents that are sent directly to a facility manager via email once setup is complete.
      d) Backup of Vive wireless hub database to Lutron cloud for hub replacement.
      e) Access to native help and instructions to assist user with Vive system setup.

j. BACnet Integration (Lutron Vive Premium wireless hub with BACnet only):
   1) Provide ability to communicate by means of native BACnet IP communication (does not require interface) to lighting control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
   2) Requires only one network connection per hub.
   3) BACnet Integrator Capabilities:
      a) The BACnet integrator can command:
      b) Area light output.
      c) Area load shed level.
      d) Area load shed enable/disable.
      e) Enable/Disable:
      f) Area occupancy sensors.
      g) Area daylighting.
      h) Daylighting level.
      i) Area occupied and unoccupied level
      j) Occupancy sensor timeouts (for fixture sensors).
   4) The BACnet integrator can monitor:
      a) Area on/off status.
      b) Area occupancy status.
      c) Area load shed status.
      d) Area instantaneous energy usage and maximum potential power usage.
      e) Enable/Disable:
      f) Area occupancy sensors.
      g) Daylighting.
      h) Timeclocks.
      i) Daylighting level.
      j) Light levels from photo sensors.

k) Area occupied and unoccupied level.
l) Occupancy sensor timeouts.

M. FIELD QUALITY CONTROL

1. Manufacturer's Full-Scope Start-Up Service:

a. On-Site Full-Scope Start-Up Service; Lutron LSC-OS-SU-VIVE: Manufacturer's authorized Service Representative to conduct site visit upon completion of lighting control system installation to perform system startup and verify proper operation:
1) Verify connection of power wiring and load circuits.
2) Verify connection and location of controls.
3) Energize wireless hubs.
4) Associate occupancy/vacancy sensors, daylight sensors, wireless remotes, and wall stations to load control devices.
5) Program timeclock schedules per approved sequence of operations.
6) Configure load shed parameters per approved sequence of operations.
7) Verify system operation control by control.
8) Obtain sign-off on system functions.

b. Train Owner's representative on system capabilities, operation, and maintenance, provide 4 hours of training.

c. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

2.10 ELECTRICAL POWER EQUIPMENT

A. Motor Controls - Manual and Solid State:

1. Individually mounted starters shall be NEMA rated solid state type with thermal overload on each reduced voltage start.

2. Motor Starters shall be furnished by Electrical Sub-Contractor unless part of package mechanical equipment such as rooftop units. Refer to equipment schedules on Electrical Plans and provide accordingly.

3. The solid state motor controller shall use silicon controlled rectifiers (SCR’s) to control the voltage to the motor windings. Two SCR’s shall be used in a back-to-back arrangement in each phase to allow alternating current to pass to the motor. When SCR triggering is delayed, the voltage to the load shall be reduced. This phase-controlled operation provides soft starting with stelpless acceleration. Once the motor is running, voltage reduction can improve the motor’s operating point at partial load, saving energy and lowering the reactive current. If one or more shorted SCRs are detected, the starter shall not energize. A fault LED will light and if provided with a shunt trip, the main circuit breaker will trip. Provide pump stop option to eliminate water hammer in pumping systems, by giving a controlled decel to the motor voltage. This process shall allow for smooth pressure reduction and quiet check valve operation. The controller shall trip off the line if one or more phases is lost.

4. Starters shall be 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 sets of auxiliary contacts of convertible type N.O. to N.C. for each starter.

e. Motor starters shall have NEMA I enclosures. Those in wet locations shall be NEMA 3R.

f. Acceptable Manufacturers:
   1) Westinghouse/Culter-Hammer
   2) Square D/Groupe Schneider
   3) Siemens
   4) Allen Bradley
   5) General Electric
   6) Or equal

5. 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. Acceptable Manufacturers:
   Westinghouse/Cuttler-Hammer
   Square D/Groupe Schneider
   Siemens
   Or Equal

D. Fuses:

1. Provide a complete set of fuses for each item of fusible type equipment. Each fuse initially installed shall be provided with Bussmann SAMI-indicating fuse covers.

2. Turn over to authorized representative of Owner upon completion a spare set of fuses of each different type and ampere rating installed. These spares shall be bound with twine and tagged.

3. Secondary system fuses, rated at 600 volts or less, shall be UL listed and constructed in conformance with the applicable standards set forth by NEMA and ANSI. All fuses of a particular class shall be of same manufacturer.

4. All fuses in distribution panelboards and switchboards shall be class “L” above 600 amperes and class “RK1” for 600 amperes and below.

5. Main, Feeder, and Branch Circuits:

   a. Circuits 601 amperes and above shall be protected by (Bussmann type KRP-C LOW-PEAK) current limiting time delay fuses.

   b. Circuits 0-600 amperes shall be protected by (Bussmann “LOW-PEAK” dual element), KPS-RK (600 volts), UL class RK-1.

6. Acceptable Manufacturers:

   a. Bussmann, Division of McGraw

   b. Gould/Shawmut

   c. GEC-ALSTHOM

   d. Or Equal

2.11 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. The Electrical Subcontractor shall provide a 120 volt source with a disconnect switch at one location next to the main automatic temperature control panel.

C. All control wiring not indicated in the electrical specifications or not shown on electrical drawings will be provided by Temperature Control Subcontractor.

2.12 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.

2.13 SWITCHBOARD

A. Main building switchboard shall be constructed in accordance with UL 891 and ANSI standards and of the required number of vertical sections bolted together to form one metal enclosed rigid structure. The sides, top, and rear shall be covered with removable plates. Switchboard shall include all protective services and equipment as listed on drawings with necessary interconnections, instrumentation, and control wiring. Buses shall be copper. Provide oversize termination lugs for any terminations requiring same due to conductor sizing.

B. Record drawings shall be furnished with the following: Complete rating, short-circuit withstandability of bus and of lowest rated device, overall outline dimensions, including space available for raceways, circuit schedule showing circuit number, device description, device fuse clip ampere rating, conductor ratings and one-line diagram with each circuit device numbered.

C. Each section shall be 90 in. high, self-supported, and same depth as incoming line section, approximately 30 in. deep. Main protective device shall be individually mounted with front coverplate and bus connection straps. Where called for on schedule, "space" shall mean to include necessary bus, supports, and connections, leaving out only the breaker itself. Bus structure shall be arranged to permit future additions.

D. Switchboard shall be arranged for operation as follows:

1. Voltage - 208Y/120 volts
2. Frequency - 60 cycles
3. Service - 3 phase, 4 wire, ampere capacity as indicated on drawings.
4. Neutral - full capacity
5. Available short circuit current at line terminals - 65,000 RMS amperes symmetrical.
6. Integrated equipment rating - 65,000 AIC
7. Copper ground bus, full length
8. UL service entrance label

E. Provide electrical metering and voltage protection system equal to Square D, Westinghouse IQ Data Plus or Siemens 4700 Series at main breaker.

1. Main service entrance device shall be an insulated-case circuit breaker (ICCB): Rating as shown on drawings, 100 percent rated, sealed circuit breaker with interrupting capacity rating to meet available fault current.
2. Fixed circuit-breaker mounting.
3. Two-step, stored-energy closing.
4. Microprocessor-based trip unit with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
5. Instantaneous trip.
6. Long- and short-time time pick-up and time delay adjustments.
7. Ground-fault pickup level, time delay, and I2t response.
8. Safety features: Phase loss protection.
9. Provide maintenance mode arc flash reduction feature on main circuit breaker.

F. Switchboard feeder protective devices shall be molded case circuit breakers. The circuit breakers 250 amperes and larger shall be with a solid-state trip, all other circuit breakers shall be of thermal-magnetic type. Breakers shall be built, tested, and labeled in accordance with UL 489.

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.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with field-replaceable rating plug 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. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
9. Standard frame sizes, trip ratings, and number of poles.
10. Lugs: Suitable for number, size, trip ratings, and conductor material.
11. Application Listing: Type HACR for heating, air conditioning and refrigeration equipment power feeders.
12. Shunt Trip: 120-V trip coil energized from separate circuit, where shown on the drawings.

H. Acceptable Manufacturers:

1. Eaton
2. Square D/Groupe Schneider
3. Siemens
4. General Electric
5. Or equal

2.14 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.

C. Cabinets shall be minimum of 20 inches wide and be made of code gauge steel. Surface type shall be ordered without knockouts.

D. Trims shall be made of code gauge steel, surface or flush as indicated. Panelboards shall be keyed alike. Trims shall be provided with full length piano hinge on one side, and secured to tub with sufficient quantity of latches opposite the hinge side to allow trim to fit flush with tub and when released, allow full access to wiring gutters. Inner door shall allow access to circuit breakers only.

E. Panelboards shall be of the following types with minimum circuit breaker frame sizes listed below. Refer to schedules for larger circuit breaker frame sizes due to fault current availability.

1. 120/208 volt, three phase, four wire. Symmetrical interrupting capacity 22,000 AIC.

	Style
General Electric type AQ	HHQB Breakers (bolt-on)
Westinghouse type PRL-1	BAB Breakers (bolt-on)
Square D type NQOD	QOB Breakers (bolt-on)
Siemens type CDP-7	BQ Breakers (bolt-on)

2. Distribution Panels

a. Where scheduled as circuit breaker type, symmetrical interrupting capacity 65,000 AIC.

General Electric type CCB	THED Breakers
Westinghouse type PRL-3	FD Breakers
Square D I-Line type	FA Breakers
Siemens SPP	FXD6 Breakers

Or Equal

F. Panelboards and distribution panels shall be of same manufacturer.

2.15 FIRE ALARM AND DETECTION SYSTEM (Voice Evacuation Required – Extension of Existing Notifier NFS 3030)

A. Description:

1. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system, via extension of existing system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, 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. Peripheral devices shall match the existing system 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. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication

7. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.

B. Scope:

1. 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.

2. 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.

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

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, and physical equipment sizes 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.
4. Submittals
    a. Submit complete documentation for the Fire Alarm/Life Safety System showing the Model Number, type, rating, size, style, Manufacturer's Names, and Manufacturer's Catalog Data Sheets for all items to ensure compliance with these Specifications. Submittals shall be prepared by a NICET level III and reviewed signed and dated by a NICET IV.
    b. Upon Contract Bid approval, and prior to start of system installation, submit Shop Drawings to and obtain written approval from the Fire Department, prior to ordering fire alarm equipment. General requirements are as follows:
        1) Submittal of fire rated sealant for penetrations.
        2) A complete point to point riser diagram of the fire alarm system including addresses and voltage drop calculations on the riser diagram. (Typical riser diagrams are not acceptable).
        3) Floor plans detailing all devices in the system with addresses, circuiting and circuit calculations.

4) A complete point to point installation diagram. (Typical installation diagrams are not acceptable). Include FACU elevations with card placement and wiring diagrams specific to the project
5) A complete list of current drain requirements during normal supervisory, trouble, and alarm condition.
6) Battery standby calculations showing total standby power required to meet the specified system requirements.
7) Supplier's qualifications indicating years in business, service policies, warranty definitions, and list of similar installations.
8) Electrical Subcontractor qualifications, indicating years in business, prior experience with installations that include the type of equipment that is to be supplied, and installers license number and type of license.
9) Circuit calculations for all Notification Appliance Circuits. Calculations shall conform to UL864 10th edition and shall be performed using 19vdc starting voltage with a drop allowance to minimum nameplate voltage for the devices on each circuit. Amplifiers shall be calculated based on the following tap settings:
   a) Gym, Cafeteria, Auditorium, rooms greater than 1,000 square feet and mechanical rooms shall be set at 2watts
   b) Corridors shall be at .5watts
   c) Classrooms shall be at 1 watt
   d) Offices shall be at .25
   e) Provide One back up amplifier for each 50 watts provided to support the system.
   f) Provide 25% spare capacity on all notification and indicating appliance circuits.

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 shall be installed in conduit or 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 accepted by the fire alarm equipment manufacturer.

e. All field wiring shall be completely supervised.

3. Terminal Boxes, Junction Boxes and Cabinets: All boxes and cabinets shall be UL listed for the intended purpose.

4. 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.

5. The use of low energy cable is not allowed.

G. 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.

H. 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. Manual pull stations shall be of the double action type.
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.

I. 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.

J. 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.

K. 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.

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.
3. Label all concealed duct smoke locations with a red phenolic label on ceiling.
4. Provide remote test stations for all duct smokes.

M. Carbon Monoxide Detector

1. Features
    a. Listed to UL standard 2075 for the Standard For Safety for Gas and Vapor Detector and Sensors
    b. Tested to UL 2075 using UL 2034 Sensitivity limits for carbon monoxide gas
    c. Surface mounts to a wall using the supplied enclosure rear housing
    d. Flush mounts in a 2 x 4 (1-1/2 inch deep minimum) [5.08 cm x 10.16 cm (3.81 cm deep minimum)] single gang switch, or handy
    e. electrical box
    f. Small, low profile, attractive unit in a white plastic case
    g. Detector alarms at multiple levels of exposure to carbon monoxide based on time weighted averages of the gas present
    h. Inexpensive, easy to install. Microcomputer control allows mostly automatic operation
    i. Test & Reset switch conducts internal tests and actuates alarm relay
    j. Visual display: Green - Normal operation
    k. FLASHING Amber - Trouble Contact your installer or Macurco Tech Support
    l. Red - Danger! Move to fresh air (hazardous condition is present)
    m. Highly linear electrochemical sensor
    n. N.O. or N.C. SPST Alarm Relay and N.C. SPST Trouble relay to connect to Alarm Control Panels
    o. Buzzer: Produces repeating loud tone bursts during alarm, and chirps if sensor trouble is found

2. Specifications
    a. Voltage: 9-32 VDC
    b. Current (normal / alarm): 15mA / 35mA @ 9-32V
    c. Size: 3-1/8 X 5-1/8 X 1-1/2 inch (7.94 x 13.02 x 3.81 cm)
    d. Alarm Relay: SPST, 100mA, 40VDC
    e. Trouble Relay: SPST, 100mA, 40VDC
    f. Buzzer Rating: 85 dBA at 10 Feet
    g. Shipping Weight: One pound
    h. Operating Temp. Range: 40°F (4.4°C) to 100°F (37.8°C)
    i. Alarm Setting: Per UL 2034
    j. Color: White
    k. Designed for use with a UL Listed Fire Alarm/Burglary Control Panel
    l. End-of-Life Indication: 10 years after installation
3. Manufacturer:
    a. Macurco CM-E1
    b. Or equal

N. 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.

O. 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.

P. 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.

Q. 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 10 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.

R. Speaker/Strobe Units:

1. One-way Tone/Voice Communication:

a. The evacuation alarm and alert signals shall be capable of being initiated automatically from the fire alarm control panel (FACP) and transmitted to any speaker circuit, selected speaker circuits or all speaker circuits.

b. The alarm signal, alert signal and live voice announcements shall be capable of manual transmission from the FACP to any speaker circuit, selected speaker circuits or all speaker circuits by manual selection of the associated speaker circuit control switches.

c. Live voice announcements, via the hand-held microphone or patched in warden phone, by use of speaker control switches, shall take priority over all previously activated alarm inputs. In addition to NFPA 72 requirements, the system shall be capable of priority live voice announcements over subsequent alarm conditions. In no case shall subsequent alarms disrupt emergency live voice announcements.

d. Alarm speaker amplification equipment shall be sized, as a minimum, to provide the following wattage levels for each location type of alarm speaker:

1) Each floor alarm speaker: Provide one watt of input power.
2) Each toilet alarm speaker: Provide one-half watt of input power.
3) Each mechanical room alarm speaker: Provide two watts of input power.
4) Each stairwell alarm speaker: Provide one-half watt of input power.
5) Assembly spaces: Provide two watts of input power.
6) Each elevator cab alarm speaker: Provide one-quarter watt of input power.

e. As a minimum, alarm speaker amplification equipment shall be sized to provide the above indicated wattage of input power to each location type of alarm speaker shown on the Drawings, plus twenty-five percent (25 percent) spare capacity to permit the addition of future alarm speakers.

f. Alarm speaker amplifiers shall be paired to provide 100 percent redundancy. One back-up alarm speaker amplifier shall be provided for each primary alarm speaker amplifier. If any primary alarm speaker amplifier fails, its function shall be taken over by its backup amplifier. Provide dedicated power amplifiers for each speaker circuit (4 min.) with one dedicated backup.

g. Alarm tone and alert tone oscillators and pre-amplifiers shall be paired to provide 100 percent redundancy.

h. As a minimum, each stairwell shall be provided with a dedicated notification appliance circuit.

i. As a minimum, the system shall be configured as a two channel voice system.

j. Within the individual assembly occupancies in this project, an alarm received during a program occupancy shall sound an alert alarm at a constantly attended location and perform the following actions:

1) Deliver a field programmable, digitized custom evacuation message to the occupants, detailing evacuation instructions.

2) A simultaneous message shall be delivered via all alarm speakers installed in remainder of the building directing evacuation using exits other than the assembly occupancy exit path.

3) Perform all control functions as detailed elsewhere in this specification

4) An automatic announcement or tone evacuation signal shall be capable of interruption by the operation of the system microphone to give voice evacuation instructions overriding the pre-programmed sequences

k. Visual Unit (Xenon Strobe):

1) Combination speaker strobe units - Provide Truealert Non-Addressable 75 Cd, Red Sync. 2-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 speaker strobe units - Provide Truealert Non-Addressable 110 Cd, Red Sync. 2-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. 2-Wire comprised of a 24 VDC Xenon flash tube entirely solid state.

2. Graphic Map: Provide graphic map to the fire department and engineer for review and approval.

a. Graphic map shall show all initiation devices and control panel and othe control locations annunciator and key boxes. All devices shall be labelled, and all final room numbers shall be indicated. The map shall be installed behind a plexiglass enclosure along with a frame equal to space age electronics GD graphic display frame.

S. Field Quality Control

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. Certified by a state or local authority.
   e. 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 100 percent devices as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.
9. Provide eight hours of customer training.

T. ELECTRONIC MASTER BOX (PROPRIETARY)

1. Provide (1) UL listed 16-zone Digitize surface mounted DET-16 16 zone solid state telegraphic code transmitter and associated wiring to the city loop in accordance with local fire department requirements. Coordinate programming with local fire department. The DET-16 shall have captive key shunt switch installed to disable box for testing or service.
2. Shunt switch will shunt the municipal circuit and will prevent the door of the electronic master box, from closing and place the fire alarm panel in trouble. The fire alarm superintendent will supply the box number.
3. All electronic masterboxes shall be connected to the grounded electrode conductor connection of the electrical system. Also, at the connection pole, a ground rod shall be driven at the base of the pole with sufficient length of #8 to reach the top of the pole. For all protected property connections a cast aluminium terminal box 5X8C10 shall be provided. Along with two (2) Model # T-113-17-A 150 to 300Volt lightning arresters shall be supplied by the E.C. to the fire alarm superintendent for connection to the municipal system.

4. E.C. to provide 2” conduit from the masterbox location to the bottom of the pole. On the pole a 10’ riser of 2” rigid conduit with a two inch weather head, and sufficient cable shall be installed ot reach the top of the pole. The cable shall be IMSA spec #20-2, or 19-3 16AWG 3 pair twisted (must be a solid wire). This cable must be run in one piece from the firebox to the pole with no splices.
5. Only factory knockouts already established in the DET-16 cabinet from the factory are to be used unless they are approved by the AHJ.
6. DET-16 shall be fed from its own dedicated circuit, clearly marked and provided with a circuit breaker lock.
7. Surge suppressor for the branch circuit shall be mounted in a cabinet adjacent to the circuit breaker panel. This cabinet shall be clearly identified. Installing contractor will wire 110 volt feed to DET16 but will not turn power on until approved by NFD or commissioning vendor.
8. All connections at DET16 to be made by NFD or commissioning vendor with the exception of zone wiring coming from FACP and 110 volt feed.
9. All DET16’s require a monitor module (supplied from installing contractor) from FACP to monitor DET16 trouble contacts. These contacts shall be latching and place a trouble on the FACP if digitize is in trouble condition.
10. DET16 will have a minimum #8 wire (depending on length) from digitize to the street side of the water main. This wire will be in its own conduit, clearly marked as fire alarm, with no junction boxes and uninterrupted as possible to the water main. The #8 shall not be “choked” or bonded to its own conduit. Installing contractor will install the #8 on its own ground clamp. Ground clamp will be clearly marked “NFD connection do NOT remove”. DET16 side of the #8 will be attached by NFD or commissioning vendor.
11. All underground cabling shall be done in IMSA 20-6, copper shielded, minimum 16 gauge solid conductors with a minimum of 2 pairs.
12. All new structures with underground installations shall be installed in a new and dedicated 4” schedule 80 PVC underground conduit to the utility pole. At the utility pole a 4” rigid metal conduit will extend a minimum of 10 feet above grade up the utility pole, secured and installed with a weather head.
13. At the structure side of an underground installation, whether inside or outside of the structure, the 4” PVC conduit will immediately terminate in a metal entry enclosure or cabinet. The cabinet will be a minimum 24”x24”. This metal entry cabinet will house the 325IM surge suppressor.
14. Only the City circuit and the #8 ground will be installed in this cabinet and the cabinet shall be clearly identified.
15. Installing contractor will mount firmly in place, and directly to the cabinet, the surge suppressor.
16. A #8 ground wire shall be run from the underground feed cabinet and attached to the street side of the water main that services the structure.
17. A minimum 3/4” conduit for IMSA 20-6 shall be installed from this cabinet to the DET16. It will be installed in as direct as possible, with no splice cans, shall be in RMC if outdoors and EMT if indoors and shall be clearly identified as fire alarm. This distance of the cable from the surge suppressor to the Digitize shall be a minimum of 6 feet to meet Digitize specifications.
18. Installing contractor shall install all IMSA-20-6 cables from the underground feed entry cabinet to the utility pole and the DET16.
19. NFD or commissioning agent will make all terminations at DET16 and the entry cabinet.

20. Installing contractor shall notify the NFD wire division when installation is complete. If NFD approves the installation then the DET16 purchasing contractor (and only them) can call the DET16 providing contractor (R.B. Allen) to inform them that the installation is ready. The purchasing vendor (R.B. Allen) and the NFD wire division will then make the appointment to program and commission the DET16.
21. DET16s can be purchased from the R.B. Allen Company of North Hampton, NH. When the Digitize is purchased, R.B. Allen should provide all surge suppressors for the complete installation. The proper installation of these devices will assure that the programming goes smoothly and that the end user will get a full warranty from R.B. Allen and Digitize.
22. Newton Fire Department will make all attempts to visit the site and work with installing contractor to make the commissioning of the DET16 as smooth as possible. All inquiries for the installation shall go through Glenn Manning or Mark Boudreau.
23. E.C. is responsible for the $200.00 connection fee.
24. E.C. shall fill out Newton wires department application for fire alarm service and coordinate connection.
25. E.C. shall comply in full with Newton Fire Department Rules and Regulations for DET installations.

2.16 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 un-encapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.
4. Minimum of ten 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 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 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:
2. Siemens Industry.
    a. Current Technology
    b. LEA
    c. Liebert
    d. APT
    e. Cutler Hammer
    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 over temperature 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

      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.

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 over temperature 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

h. 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

i. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.

j. Suppression components shall be heavy duty ‘large block’ MOVs, each exceeding 30mm diameter.

k. SPD shall include a serviceable, replaceable module.

l. 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

      No other test equipment shall be required for SPD monitoring or testing before or after installation.

m. SPD shall have a response time no greater than 1/2 nanosecond.

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	L-G	N-G	L-L	MCOV
208Y/120	800V	800V	800V	1200V	150V

d. 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

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. The unit shall have removable interior.

k. The main bus shall be [copper] [aluminum] and rated for the load current required.

l. The unit shall include a 200 percent rated neutral assembly with copper neutral bus.

m. The unit shall be provided with a safety ground bus.

n. The field connections to the panelboard shall be main lug or main breaker.

o. 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.

2.17 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.

2. Fittings on the outside of the conduit shall be O-Z Gedney type FSK or approved equal. Provide type WSK if penetration is within two feet of the high water table. Provide grounding attachment.

a. Fittings on the inside of the conduit shall be O-Z Gedney type CSBI or approved 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.

b. O-Z Gedney type CSM fitting may be used when sealing within a sleeve or cored hole.

3. 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.

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 with 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.

2.18 LADDER TRAY/WIREWAYS

A. Provide aluminum ladder tray with 6 in. rung spacing with 4 in. side rail. Ladder tray shall be as manufactured by B-Line. “Ladder Type”. Provide all hangers required. The width of the ladder tray shall be as indicated on drawings.

1. Acceptable Manufacturers:

   a. B-Line

   b. Chalfant

   c. Chatsworth

   d. PW Industries

   e. Or equal

B. Provide wireways for power and data where shown on drawings.

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 manufactured by the MP Husky. The size of the cable maximum of 40% fill is allowed.

   a. Acceptable Manufacturers:
      1) MP Husky
      2) Wiremold Company
      3) Hoffman
      4) Or equal

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° and 90° 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

2.19 FIRESTOP SYSTEMS

A. General: Provide firestopping at all 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.

2.20 ELECTRIC SERVICE

A. Coordinate and cooperate with Eversource, hereinafter called utility company, with respect to providing service and metering.

B. Provide all system raceways, elbows, pull wires, grounding for vault including mesh. 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 utility company.

D. All work to be done in accordance with utility company standards.

E. Metering: All usage will be on one secondary meter. Utility Company will furnish current transformers and potential transformers to be installed in the CT section of the main switchboard for cold sequence metering. Meter socket shall be provided under this section and located in accordance with Utility Company Standards. Meter will be by Utility Company. Meters shall be ordered with KYZ Pulse output for connection to Building Management System.

2.21 EMERGENCY BATTERY SYSTEM

A. Provide a 12 volt emergency battery system constructed in accordance with UL Standard 924 and installed in accordance with Article 700 of the Electrical Code in locations indicated on the Drawings.

B. Battery units and remote heads shall be as manufactured by Emergi-Lite, Inc., Chloride, Inc., Dual Light, Mule Lighting, or equal and shall be of the voltage, capacity and model indicated on the Drawings. Provide units of capacities as required to meet the number of lighting fixtures connected to each unit. Batteries shall be NRTL listed for carrying rated load for 90 minutes.

C. Battery unit shall be arranged for 60 cycle input with AC voltage as indicated on the Drawings, including heavy gauge sheet cabinet with fully automatic solid-state controlled charger. Unit shall be fully restorable in 12 hours or less and shall include Trickle charger, heavy duty two contact AC supervisory relay, voltmeter, ammeter, protection fuse, ready pilot light, charging pilot light, test switch, knockouts provided in housing for both AC input and DC output to remote heads. Unit shall be provided in the wall-mounting hardware.

D. Provide five minute time delay relay to maintain emergency lighting in HID source lighted areas for three minutes after return of normal power.

E. Remote heads shall be of the voltage, wattage and type indicated on the Drawings and shall be housed in an aluminum cylinder with fully adjustable swivel-mounted on a single gang stainless switch plate unless indicated otherwise on Contract Drawings.

F. Exit signs shall be provided as specified on the lighting fixture schedule.

2.22 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. 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.

2.23 VARIABLE FREQUENCY DRIVES

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.
5. All VFD’s that serve the Atrium Smoke exhaust system shall have the display locked out via a passcode after the commissioning of the system. It should not be possible to adjust VFD’s while the system is in alarm mode.
6. 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):
7. Output Frequency
8. Motor Speed (RPM, percent or Engineering units)
9. Motor Current
10. Calculated Motor Torque
11. Calculated Motor Power
12. DC Bus Voltage
13. Output Voltage
14. Heatsink Temperature

15. Analog Input Values
16. Keypad Reference Values
17. Elapsed Time Meter
18. kWh meter

E. 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.

F. 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 or LED’s lights 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.

G. 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 line reactors 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.

H. 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.

I. Access: Provide access space around control panels for service as indicated, but in no case less than that recommended by manufacturer.

J. Support: Install drive control panels on walls where indicated on drawings. Provide necessary Unistrut and structural steel to provide adequate support.

K. 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.

L. 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.

M. 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.

N. Acceptable Manufacturers:

1. Allen – Bradley
2. ABB
3. Siemens
4. Square D
5. Or equal

2.24 EMERGENCY RESPONDER RADIO SIGNAL AMPLIFICATION SYSTEM (BDA SYSTEM)

A. SUMMARY

1. 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.
2. Provide pre-test for the to determine coverage.

B. ABBREVIATIONS AND ACRONYMS

1. ACG: Automatic Gain Control
2. AHJ: Authority Having Jurisdiction
3. ATP: Acceptance Test Plan
4. BDA: Bi-Direction Amplifier
5. BOM: Bill-of-Material
6. DAS: Distributed Antenna System
7. EBS: Educational Broadband Service
8. ESMR: Enhanced Specialized Mobile Radio
9. FCC: Federal Communications Commission
10. GUI: Graphical User Interface
11. LMR: Land Mobile Radio
12. MTBF: Mean Time Between Failure
13. NFPA: National Fire Protection Association
14. NMS: Network Management System
15. PSN: Public Safety Network
16. RoF: Radio-over-Fiber
17. RSL: Received Signal Level
18. SMR: Specialized Mobile Radio
19. SMS: Short Message Service
20. SNIR: Signal-to-Noise Interference Ratio
21. SOW: Statement of Work
22. VSWR: Voltage Standing Wave Ratio

C. DEFINITIONS

1. Acceptance: Expressed approval by the AHJ and owners representative

D. GENERAL DESCRIPTION

1. 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.

2. 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.

3. 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.

    a. 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 and Police Departments equipment.

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.

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

h. The system shall comply with the requirements of the Massachusetts State Building Code (780 CMR), 8th Edition as amended on April 11, 2014 and NFPA-72, 2013 edition, as referenced.
i. The entire system shall meet with approval of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).
j. The work in this section shall include the responsibility for all fillings with the AHJ, as required. This responsibility shall include furnishing of floor plans, descriptive notes and/or specifications, wiring diagrams, certifications, shop drawings and amendment forms.
k. Early completion of the in-building radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner
l. 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 as the part of the required work.

H. DESIGN REQUIREMENTS

1. 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.
2. 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.
3. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.
4. The In-building radio signal amplification 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.
5. 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.
6. Electrical SubContractor shall sub-contract an approved manufacturer or a qualified and approved radio systems vendor to supply, test and determine locations of components which are required for proper operation as well as to supply, deploy, test and certify the performance of the complete system. Vendor qualifications and must also be acceptable to the AHJ.
7. All installation and testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must also be acceptable to the AHJ.
8. The system design is based on the RSI branded line of Public Safety NFPA-72 and FCC compliant Signal Boosters as manufactured by Radio Solutions, Inc. 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.
9. 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.
10. Survivability from attack by fire shall meet NFPA 72, National Fire Alarm and Signaling Code, 2013 edition

11. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.

12. Antenna isolation shall be maintained between the donor antenna and all inside antennas to a minimum of 20dB under all operating and environmental conditions.

I. TECHNICAL SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

1. The system specified is based upon RSI branded line of Public Safety NFPA-72 compliant signal boosters. Provide RSI or equal.

2. The signal booster shall be either a Class B or a Class A Public Safety type as designated by the FCC and as required by the AHJ.

3. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA-72, 2013 edition. The signal booster shall have both the primary and the secondary power supplies fully enclosed in a sealed, non-vented NEMA-4 enclosure.

4. 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 brochures and technical submittals. The ID must also be displayed on the product as required by the FCC.

5. Equipment installation must be done in accordance with the OEM (original equipment manufacturer) specifications. External filters, attachments or other non-approved aftermarket modifications of the original equipment shall not be accepted.

6. The signal booster shall be set and tuned by the equipment manufacturer to pass all frequencies specified by the local fire department.

7. To reduce the possibility of unwanted interference affecting the operation of the system, signal boosters shall be of a band-selective or channel-selective type with a maximum 200KHz (Fc +/- 100KHz) 3dB channel bandwidth. Wide-band, non-selective signal boosters shall not be accepted unless it is required to cover multiple consecutive channels within the same band, or if specified by the AHJ.

8. Signal Boosters shall have oscillation prevention circuitry to protect the public safety radio system in case of signal booster malfunction.

9. Signal Boosters shall have a minimum of 80dB gain. The gain shall be adjustable in a minimum of 25dB range. System gain shall be set and documented at the time of the final system test.

10. Maximum Propagation delay of the signal booster system shall be 14μs (microseconds) or as specified by AHJ.

11. The signal booster shall include built-in automatic alarming of malfunctions of the signal booster and battery system as per NFPA 72, 2013 Edition, Sections 24.5.2.6.1, and 24.5.2.6.2. Aftermarket equipment add-ons and modifications to comply with this specification will not be accepted.

12. A dedicated monitoring panel shall be provided within the emergency command center 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:

    a. Normal AC power

    b. Signal booster trouble

    c. Loss of normal AC power

    d. Failure of battery charger

e. Low battery capacity

13. The system installation vendor shall verify the system monitoring requirements with the AHJ prior to system installation. System monitoring shall be fully compliant with the AHJ requirements.

14. All signal booster components shall be contained in a NEMA4 rated waterproof cabinet. Signal booster and battery backup enclosures shall be painted red with signage in bright yellow or as required by AHJ.

J. INSTALLATION REQUIREMENTS

1. Assembly and installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code, NFPA-70 and the National Fire Alarm and Signaling Code, NFPA-72, current enforceable editions.

2. At least 2 independent and reliable power supplies shall be provided as specified in sections 3 and 4 below.

3. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA-70 National Electrical Code, and NFPA 72, National Fire Alarm and Signaling Code, 2013 edition

4. The emergency responder radio coverage enhancement system 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 supply power automatically when the primary power source is lost. The secondary source of power shall be capable of powering the emergency responder radio coverage enhancement system for a minimum period of 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 non-vented NEMA-4 rated enclosure. Batteries shall be enclosed in a separate, vented NEMA rated enclosure.

5. 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.

6. External UPS (Uninterruptable Power Supplies) are not acceptable

7. 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.

8. 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.

9. 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.

10. 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.

11. Coaxial Riser cables shall be 2 hour rated.

K. INSTALLATION

1. The BDA System SubContractor shall install the BDA in accordance with the integrator's instructions and recommendations.
2. 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.
3. 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.
4. 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.
5. All equipment shall be properly mounted on equipment racks or walls and secured in place. Wall mounted equipment shall be mounted over a ½" plywood securely attached to the wall.
6. 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.
7. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three.
8. All boxes, equipment, etc shall be secured plumb, level and square.
9. 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
10. All cables, regardless of length, shall be marked with cable markers reading "Newton Fire Dept. Radio system antenna", at regular intervals but not less than every 4 ft. The signage shall consist of a 4" long X 2" high red background and white inch high letters. 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. Label shall be per Newton fire dept. requirements.
11. 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
12. 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.
13. Connection between cables and other antenna components shall use N-Type premium connectors. No splicing is permitted.

14. 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.

L. GROUNDING PROCEDURE

1. 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:
2. 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.
3. 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.
4. 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.
5. Under no conditions shall the AC neutral conductor, either in the power panel or in receptacle outlets, be used for a BDA system ground.
6. Radio cable Shields: All radio cable shields shall be grounded at both ends.
7. 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.

M. CABLE AND CONDUIT

1. Note the following circuitry requirements:
    a. Conduit intended for use with the firefighter’s communication bi-directional radio amplifier system shall be steel electric metallic tubing (EMT), except as follows:
        1) It shall be galvanized steel intermediate conduit where mounted within 8’-0” of the floor in mechanical spaces or otherwise exposed to mechanical damage, or where intended for embedment in concrete.
        2) It shall be galvanized steel intermediate conduit if local authorities prohibit use of EMT.
        3) 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.
    b. 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.
    c. 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.

d. Comply with applicable building and electrical code requirements for locating and routing circuitry, for installing circuitry, and for fire stopping.

e. 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.

f. 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.

g. 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.

N. ACCEPTANCE TESTING

1. Acceptance and Test Procedures

a. Acceptance testing for an in-building radio system is required upon completion of installation.

b. 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

c. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.

d. 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.

2.25 TWO WAY COMMUNICATIONS CALL BOXES

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. Call Boxes are to be located on all floors above and below the first floor, ideally next to a stairwell emergency exit or elevator landing on each floor.

b. The Area of Refuge Base Station must be capable of handling a minimum of 5 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. via landline, cellular device (part # 2100-GSMLC or 2100-CDMALC), or IP (part # 2100-VOIP). Provide all three methods in bid.

B. SUBMITTALS

1. Submit product data sheets. Include operations manuals.

2. Submit wiring diagrams detailing wiring schematics and cabling.

C. MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Aiphone is Basis of Design.
   a. Rath Area of Refuge
   b. Aiphone
   c. Or Equal.

D. 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 powered, and maintain back-up power for 4 hours.
   b. 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.
   c. 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.
   d. The Area of Refuge Call Boxes are to be located no higher than 48” above ground level to ensure conformance with the ADA requirements.
   e. The Area of Refuge Call Boxes must have a Braille faceplate located no higher than 48” for front reach and 54” for side reach above ground level to ensure conformance with the ADA requirements.
   f. The Area of Refuge Base Station must provide an audible and visual indicator that a Call Box has been activated.
   g. The area of Refuge 24vac Power Supply model 2500-PWR24U must be capable of supplying power to a minimum of 10 Call Boxes. (does not power Base Station)
2. Mounting
   a. The Area of Refuge Base Station is to be mounted on a wall flush mounted.
   b. Areas of Refuge *Call Boxes* are to be wall flush mounted.
3. Electrical
   a. Call Boxes and Base Station are to be powered by RATH® 24vdc Power Supply part # 2500-PWR24. Base Station to have option of 120vac power.
   b. Wiring from the Base Station to the Call Boxes shall be CI 2 hour fire-rated cable, use RATH® Communication Cable part # RP6600300M. 2 hour fire rated cable is required and shall be provided.
   c. Call Boxes must have built-in battery backup and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time. If Call Boxes require protective covers per local municipal codes, use RATH® 2100-XXXSSRC2.
   d. Base Station must have a built-in battery backup and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time.
   e. 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. 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.

   c. 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.

   d. 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.

   e. 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.

   f. Once call has been made (button pushed), the call can only be terminated by the called party.

   g. 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.

   h. The Call Box must be capable of being programmed and reprogrammed on-site and remotely.

   i. Standard Call Box features:
      1) Five number programming.
      2) Operating Temperature of between -40˚F to +150˚F (-40˚ to + 65˚ C)
      3) Programmable passwords.
      4) On-Site or Remote Programmable.
      5) EEPROM memory to protect programming.

5. Signage

   a. System shall consist of a minimum of one 120/277vac edge light sign (part # 7050 or 7050E), and a “location” and “instruction” sign (part # 7049SS) to clearly indicate location of designated area. A tactile sign (part # 7043/7044 or 7087) with raised letter and Braille shall be located at entrance to area.

6. Monitoring

   a. Off-Site monitoring of the system shall be provided by Rath Monitoring.

   b. Must be a UL Listed monitoring service provider

   c. Minimum 3 year agreement for monitoring of the system.

   d. Call Boxes shall dial Rath Monitoring at 800-xxx-xxxx.

7. Graphics

   a. Area of Refuge Base Station must include wording identifying the location of each Call Box and light an LED when a particular Call Box has been activated.

   b. Call Box wording must include “Emergency Phone”, “International Phone symbol” and raised Braille lettering.

8. Cabling

   a. Cabling for two-way communication system shall meet the applicable requirements for pathway survivability. Cabling installation shall consist of one or more of the following:

   b. 2 hour fire-rated circuit integrity (CI) cable – RATH® Part # RP6600300M (for a UL Listed option use part # RPP66010002)

   c. 2 hour fire-rated cable system

E. 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.

F. ADJUSTING

1. On-Site Assistance: Engage a factory-authorized service representative to provide on-site 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 three visits to Project during other-than-normal occupancy hours for this purpose.

G. DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address and mass notification systems and equipment.

H. WARRANTY

1. The Base Station and Call Boxes shall be warranted for a period of three years.

PART 3 - EXECUTION

3.1 WORK COORDINATION AND JOB OPERATIONS

A. INSPECTION AND ACCEPTANCE

1. Examine all surfaces and contiguous elements to receive work of this section and correct, as part of the Work of this Contract, any defects affecting installation. Commencement of work will be construed as complete acceptability of surfaces and contiguous elements.

B. WORK COORDINATION AND JOB OPERATIONS

1. 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.

2. 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.
3. Furnish to General Contractor and other subcontractors information relative to portions of electrical installation that will affect other trades sufficiently in advance so that they may plan their work and installation.
4. 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.
5. 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 other obstructions.

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 1/4 in. high. Nameplates on panelboards shall have the following information.
    a. Line 1 - Panel designation in 1/2 in. high letters.
    b. Line 2 - Utilization voltage in 3/8 in. high letters.
    c. Line 3 - Distribution source "Fed from 1/4 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” high by 10” width with 2-inch high block letters a 0.5” 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. All devices including receptacles and swtich covers shall be labled with circuit and panel designation. Label shall be phenolic with white engraving. Provide sample for approval.
11. Equipment nameplates shall include date of manufactuer.
12. 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.
13. 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.

14. 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.

15. 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.

16. 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.

17. 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.

18. 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.

19. 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.

20. 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.

21. 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.

22. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

23. Apply identification devices to surfaces that require finish after completing finish work.

24. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

25. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

26. 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.

27. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

28. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

29. Outdoors: UV-stabilized nylon.

30. In Spaces Handling Environmental Air: Plenum rated.

31. 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.

32. 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.

33. 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.

34. 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.

n. 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. Fire alarm pull stations - 48 inches.
4. Fire alarm audio visual signals - 80 inches or 6 inches below ceiling, whichever is lower.
5. Panelboards for lighting, power, telephone, and other auxiliary systems - 68 in. to top.
6. Equipment located in lobbies shall be located as detailed on architectural drawings or as directed by Architect.
7. All receptacles, light switches, and fire alarm signals sharing a common location shall be symmetrically arranged.
8. 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 and the requirement of 230548 Vibration Control and Seismic Restraints.

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.

15. electrical subcontractor to provide "in process" panel schedule sheet while loads are being connected. Electrical subcontractor to review phase loading at panelboards at the end of work and prior to closeout to ensure balanced loading. Provide a final typed panel schedule at completion of work.

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.
7. Refer to section 230548 Vibration Control and Seismic Restraints for additional requirements.

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 main building switchboard and/or 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 and fuses.

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. Shared neutrals are not allowed. Any combination of homeruns such as this, however, shall be indicated on record drawings. Combining of conductors and raceways for tenant fitup work is allowed only for fitup boxes in accordance with details on drawings.

When a common grounded conductor is used for more than one circuit, the arrangement shall be such that a receptacle, fixture, or other device may be removed or disconnected without disconnecting the grounded conductor for other circuits. Ground fault circuit breakers and isolated ground outlets shall be wired with separate neutrals and separate grounding conductors per circuit. A consistent phase orientation shall be adhered to throughout project at terminations.

C. Circuits feeding three phase equipment shall not be combined into common raceways, unless specifically indicated.

D. All wiring in panelboards and cabinets shall be neatly formed and grouped.

3.11 FIREPROOFING AND WATERPROOFING

A. General: Install firestop systems at all new and existing fire-rated construction where penetrated by the Work of this Section.

B. Refer to Section 078400 - Firestopping, for all installation requirements for maintaining integrity of fire-rated construction at penetrations.

3.12 CUTTING AND PATCHING

A. Core drilling, up to and including 8” in diameter, and cutting equivalent to or less than the cross-sectional equivalent of 8” square shall be performed by the Electrical Sub-contractor. Sleeves and box-outs shall be provided by the Electrical Contractor regardless of size. Cutting of surfaces, including core drilling of walls and slabs, shall be done by Electrical Subcontractor. Openings through new wall surfaces will be provided by General Contractor if Electrical Subcontractor gives suitable notice as erection of surface proceeds. If suitable notice is not given, Electrical Subcontractor shall then be responsible for cost of corrective work required.

B. Notify Masonry Sub-Contractor of exact locations and sizes for openings required in masonry, to be executed under Section 042000 – Unit Masonry, utilizing lintels furnished per Section 055000 – Metal Fabrications.

C. Cut openings in new and existing non-masonry construction where required for penetrations. All cutting shall conform to the requirements of Section 017329 – Cutting and Patching, and 024119 – Demolition.

D. Refer to Section 024119 – Demolition for restrictions on all alterations to structural elements.

E. 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. Dedicated 120V 20A/1P circuit receptacle and fused disconnect switch for communications equipment.

    h. Power to automatic damper in hoistway penthouse louver.

2. 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.

3.14 MECHANICAL SYSTEM COORDINATION

A. The Mechanical System Subcontractor will be providing various items of mechanical services equipment and control apparatus. In general, Electrical Subcontractor shall provide disconnecting means and starters and connect up power wiring to this equipment.

B. The Mechanical and Electrical Subcontractor shall closely coordinate their respective portions of work.

C. If, due to local regulations, electric heating equipment furnished by the mechanical systems subcontractor is required to be installed by licensed electricians in order to allow connection by Electrical Subcontractor's licensed electricians, it will then be Mechanical Subcontractor's responsibility to engage and pay for services of such licensed electricians.

D. Power wiring to be provided by Electrical Subcontractor is the line voltage power supply wiring. Control wiring is responsibility of Mechanical System Subcontractor unless specifically indicated on electrical drawings, or in this Division of the specifications. Temperature Control Subcontractor shall refer to electrical drawings for location of all magnetic starters provided by the Electrical Contractor.

E. 120 volt control wiring source to one temperature control panel is the responsibility of Electrical Subcontractor.

3.15 DISTRIBUTION EQUIPMENT FIELD 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 1995 Acceptance Testing Specifications of the International Electrical Testing Association.

B. The Testing Subcontractor may be an independent contractor or a manufacturer of the equipment, which is to be tested.

C. Test report forms, delineating tests to be made, and method of recording same shall be submitted prior to commencing work. Test reports when submitted shall include interpretation of results and recommendation for any corrective work required.

D. Main Distribution Switchboard and 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: All secondary service conductors and all feeder conductors from switchboards and distribution panels shall be tested.

1. Visual and mechanical inspection: Conductors to be inspected for physical damage and proper connection and sizing in accordance with single line diagram.

2. Conductor connections shall be torque tested to manufacturer's recommended values.

3. Electrical Tests: Perform insulation resistance test on each conductor with respect to ground and adjacent conductor.

4. Perform continuity test to insure proper conductor connection.

G. All secondary service conductors and all feeder conductors from switchboards and distribution panels shall be tested.

1. Visual and mechanical inspection

   Conductors to be inspected for physical damage and proper connection and sizing in accordance with single line diagram.

   Conductor connections shall be torque tested to manufacturer's recommended values.

2. Electrical Tests:

   Perform insulation resistance test on each conductor with respect to ground and adjacent conductor.

   Perform continuity test to insure proper conductor connection.

3.16 FAULT CURRENT AND COORDINATION STUDY

A. Trade Contract:

1. Work of this Section is part of the Electrical trade contract. Refer to Section 26 00 00 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.

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 (5) 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/cm^2)
   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 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.

3.18 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 017419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

3.19 TRAINING

A. All training shall be scheduled with the user. Training shall be videotaped and a DVD delivered to the Owner. Refer to each specific system for amount of training required.

END OF SECTION

SECTION 311300

SELECTIVE TREE AND SHRUB REMOVAL AND TRIMMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pruning existing tree vegetation.
2. Coordinating and scheduling of pruning inspections.
3. Inspection of trees by Certified Arborist.

B. Related Sections:

1. Section 015639 “TEMPORARY TREE AND PLANT PROTECTION” for general protection of existing trees and shrubs.
2. Section 312300 “EXCAVATION & FILL FOR UTILITIES AND PAVEMENT” for site preparation.
3. Section 312500 "EROSION AND SEDIMENTATION CONTROLS" for temporary erosion and sedimentation control measures.

1.3 DEFINITIONS

A. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

C. Vegetation: Trees, shrubs, groundcovers, grass, and other plants

D. Caliper: Diameter of a trunk measured by a diameter tape at 4’-6” above the ground or DBH (diameter at breast height). (Standard as defined by the ISA – International Society for Arboriculture).

E. Arborist or Certified Arborist: As referenced here in all “arborists” or “certified arborists” shall be at minimum an ISA Certified Arborist or and ASCA Registered Consulting Arborist unless other specified.

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain the Owner's property, all removed or pruned materials shall become Contractor's property and shall be removed from Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor shall provide a written Tree Pruning Schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

B. Contractor shall provide certification from an arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that those trees were promptly and properly treated and repaired when damaged.

C. Contractor shall provide maintenance recommendations from an arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Contractor shall provide documentation of existing trees and plantings indicated to remain, which shall establish preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.7 QUALITY ASSURANCE

A. Tree Pruning Standard: Comply with ANSI A300 Pruning Standards.

B. Arborist Qualifications: An experienced arborist certified by ISA, be licensed in the jurisdiction where Project is located, and be a current member of ASCA, or registered Consulting Arborist as designated by ASCA.

C. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to selective removal and trimming including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
b. Enforcing tree protection zones protection.
c. Arborist's responsibilities.
d. Field quality control.

1.8 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Contractor shall not direct vehicle or equipment exhaust towards protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tree Protection Fencing and Signage Materials: Requirements for satisfactory soil material are specified in Section 015639 “TEMPORARY TREE PROTECTION AND PLANT PROTECTION"

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag or wrap a 1-inch (25-mm) blue vinyl tie tape flag around each tree trunk at 54 inches (1372 mm) above the ground.

C. Protect existing site improvements to remain from damage during construction.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. General: Protect trees and plants remaining on-site according to requirements in Section 312500 "EROSION AND SEDIMENTATION CONTROLS".

B. 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 erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

C. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

D. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

E. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 PROTECTION ZONES

A. General: Protect trees and plants remaining on-site according to requirements in Section 015639 "TEMPORARY TREE AND PLANT PROTECTION".

B. Contractor shall install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area.

C. Contractor shall install protection-zone signage in visibly prominent locations in a manner approved by the Utility.

D. Contractor shall repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by the Utility.

E. Contractor shall maintain protection-zone fencing and signage in good condition as acceptable to the Utility and remove when construction operations are complete and equipment has been removed from the site.

3.4 EXCAVATION

A. General: Protect trees and plants remaining on-site according to requirements in Section 015639 "TEMPORARY TREE AND PLANT PROTECTION".

B. Contractor shall backfill holes and depressions with approved site soil or imported topsoil. Compact dampened soil to 85-percent. Water to settle. Add soil and grade to conform continuously to adjacent existing grades.

C. Where utility trenches are required within protection zones, the Contractor shall hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Contractor shall not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

D. Contractor shall not allow exposed roots to dry out before placing permanent backfill.

3.5 FELLING

A. Fell trees to prevent damage to adjacent structures and to those trees and shrubs designated to remain.

B. Remove stumps and roots to a clear depth of 36-inches (0.9 m) below existing grades in areas of lawn, and to full-depth in areas of paving, building footings, or utility structures.

3.6 PRUNING

A. Pruning shall be performed by a certified arborist. Prune trees over winter, between the months of November and March. Trees may be pruned at other times of the year, provided that the Contractor submits to the owner for acceptance a scheduled time, and a description of pruning methods and materials.

B. Prune trees according to ANSI A300 Pruning Standards.

C. Where necessary, repairs to damaged wood shall be performed under the direction of the Owner, or a certified arborist.

D. Evergreens shall only be pruned to remove dead, broken or damaged branches.

E. Perform pruning using scissors-style cutting devices, and not anvil-style hand pruners, pole pruners or loppers

3.7 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends; Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in 312300 “EXCAVATION & FILL FOR UTILITIES AND PAVEMENT”.

B. Root Pruning at Edge of Protection Zone: flush with the edge of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.8 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:

a. Type of Pruning: Cleaning and Raising.
b. Specialty Pruning: Restoration.

3. Cut branches with sharp pruning instruments; do not break or chop.
4. Do not apply pruning paint to wounds.

B. Chip removed branches and dispose of off-site.

3.9 REGRADING

A. Where new finish grade is indicated below existing grade around trees, Contractor shall slope grade beyond the protection zone. Contractor shall maintain existing grades within the protection zone.

B. Where new finish grade is indicated above existing grade around trees, Contractor shall slope grade beyond the protection zone. Contractor shall maintain existing grades within the protection zone.

C. Where existing grade within the Protection Zone is 2 inches or less below elevation of finish grade, Contractor shall fill with topsoil. Contractor shall place topsoil in a single uncompacted layer and hand grade to required finish grade elevations.

3.10 FIELD QUALITY CONTROL

A. Contractor shall engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.11 REPAIR AND REPLACEMENT

A. Contractor shall repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by the Owner’s Representative.

1. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
3. Perform repairs within 24 hours.
4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by the Owner’s Representative.

END OF SECTION 311300

SECTION 312300

EXCAVATION AND FILL FOR UTILITIES AND PAVEMENT

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 (excluding earthwork for building and retaining wall construction), including but not limited to the following:

1. Excavation, backfill, and compaction for pavements, pads, utility trenches and structures, and landscaping.

2. Preparation and protection of subgrades.

3. Removal of underground utilities as applicable.

4. Excavation of all unsuitable materials encountered below indicated subgrade elevations.

5. Placement of subbase course for concrete pavements.

6. Placement of subbase and base course for asphalt paving.

7. Bedding for utility trenches.

8. Dewatering and support of excavation of trenches and excavations.

9. Removal of items covered by Section 012200 - UNIT PRICES as applicable.

10. Disposal of unsuitable or excess excavated material.

11. Coordinate with all trades for complete building and site utility systems.

12. Coordination with maintenance of safe path of travel for the public.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. SECTION 31 20 00 - EARTHWORK for building related soil materials, excavating and backfilling requirements.

2. SECTION 311000 - SITE CLEARING for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements.

3. SECTION 312316 – ROCK REMOVAL for rock excavation and handling requirements.

4. SECTION 312500 – EROSION AND SEDIMENTATION CONTROLS for temporary erosion and sedimentation control measures.

5. Division 02, 22, 23, and 26 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

6. SECTION 333000 – SANITARY SEWERAGE UTILITIES for installing underground sewer pipes and manholes.

7. SECTION 334000 – STORM DRAINAGE UTILITIES for installing underground drain pipes, manholes, area drains, water quality structures, and water storage tanks.

1.3 UNIT PRICES

A. Unit prices for certain types of earthwork are included in Section 012200 - UNIT PRICES.

B. Rock Measurement: Volume of rock actually removed as specified in Section 312316, Rock Removal. Unit prices for rock excavation include replacement with approved materials as further defined in Section 312316, Rock Removal.

1.4 DEFINITIONS

A. Backfill: Soil material or Controlled Density Fill (CDF) used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving and concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture of heaving of the bottom of any excavation; and disposing of pumped water.

1. Normal dewatering is defined as using conventional pumps installed in open excavations ditches, or sumps.

F. Drainage Course: Course supporting the pavement that also minimizes upward capillary flow of pore water.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Owner's Representative or the Designer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Owner's Representative or the Designer. Unauthorized excavation, as well as remedial work directed by Designer, shall be without additional compensation.

H. Fill: Soil materials used to raise existing grades.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material as defined in Section 312316, Rock Removal, that cannot be removed by normal rock excavating equipment without systematic drilling, ram hammering, ripping, or blasting, when permitted.

J. 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.

K. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

M. Utilities: Onsite underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

N. Unsuitable Soils: Excavated soils that are determined by the Designer to not be reusable as fill or backfill on-site due to gradation, moisture content, and/or the presence of deleterious materials.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: For the following:

1. Each type of plastic warning tape.

2. Geotextile.

3. Controlled Density Fill, including design mixture.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.

2. Laboratory compaction curve according to ASTM D 1557 for each onsite and borrow soil material proposed for fill and backfill.

D. Dewatering system: Contractor shall submit, for record, drawings and design data prepared, stamped, and signed by a registered professional engineer in the Commonwealth of Massachusetts who is experienced in groundwater control system design. The submittal shall show arrangement locations, and details of wells and well points and sump pumps; locations of risers, headers, filters, pumps, power units, all treatment components, and discharge lines; and means of discharge, control of sediment, and disposal of water. The submittal of the dewatering system will not relieve the Contractor from the responsibility for the adequacy of the dewatering system to achieve the required results specified in these Specifications and all permit requirements.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.

2. Include a written plan for dewatering operations including control procedures to be adapted if dewatering problems arise.

3. Include design calculations demonstrating adequacy of the proposed dewatering system and equipment.

4. Provisions and methods of sediment removal and disposal of water.

5. All permits required for the work.

E. Support of Excavation: Contractor shall submit, for record, proposed excavation support systems (if required). The proposed lateral support systems shall be designed and stamped by a registered professional engineer licensed in the Commonwealth of Massachusetts. Despite the submittal of the design of excavation support and protection systems, the Contractor shall remain solely responsible for the adequacy and safety of materials and methods used in construction. Include the following as a minimum on the drawings:

1. Details, arrangements, and methods of construction of the proposed system(s).

2. The method of installation and installation equipment.

3. The elevation of struts, shores, and tiebacks, as applicable, and permissible depth to which excavation may be carried before such supports are installed.

4. The excavation depths, the depth below the main excavation to which the support system will be installed, and the maximum design load to be carried by various members of the support system.

5. Design calculations including references to design methods used, assumptions, design parameters, design soil profile, material properties, allowable stresses, and other pertinent information stamped by a Professional Engineer registered in the Commonwealth of Massachusetts.

6. The location of existing utilities, facilities and/or structures nearby.

F. Pre-Excavation Photographs and Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins. Maintain catalog of up-to-date photographs at the site.

G. Plan to Maintain Safe Path of Travel: Submit plans for maintaining safe paths of travel for the general public during the entire project, including requirement for police details of necessary.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted in writing by the Owner's Representative and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify the Owner's Representative not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without the Owner's Representative's written permission.

3. Contact utility-locator service for area where Project is located before excavating.

a. The Contractor shall notify "Dig Safe" at 1-888-DIG-SAFE prior to commencing any excavation work.

B. Demolish and completely remove from site existing underground utilities and structures indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Neither the Owner nor the Geotechnical Engineer will be responsible for interpretations or conclusions drawn from the data.

1. The geotechnical report does not represent, and shall not be construed to represent a guarantee of subsurface conditions.

2. Interpretation of this data for purposes of construction is the responsibility of the Contractor. It is the Contractor's responsibility to make interpretations and draw conclusions with respect to the character of materials to be encountered and groundwater conditions at the site and their impact upon Contractor's work based on his expert knowledge of the area, construction dewatering methods, and support of excavation methods.

3. Make additional test borings and conduct other exploratory operations necessary for dewatering and excavation support and protection.

4. The geotechnical report is referenced elsewhere in the Project Manual.

D. Survey Work: Contractor shall engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact

elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During earth moving operations, installation of excavation support and protection systems and dewatering, 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.

E. The Contractor shall not close or obstruct any street, sidewalk, or passageway without written permission from authorities having jurisdiction unless otherwise indicated on the Contract Drawings. The Contractor shall conduct the construction operations as to minimize interference with the use of roads, driveways, or other facilities near enough to the project to be affected by the work.

F. The Contractor shall provide police details when working in roadways as required by local jurisdictional authorities. The Contractor shall pay for any and all police details.

1.7 EXCAVATION SUPPORT AND PROTECTION

A. The Contractor shall furnish, install, monitor and maintain excavation support and protection systems (sheeting, shoring, and bracing) at locations necessary to support the sides of excavations and resist soil and hydrostatic pressure and superimposed and construction loads; to prevent danger to persons or damage to adjacent pavements, facilities, utilities, or structures; to prevent injurious caving or erosion or the loss of ground; and to maintain pedestrian and vehicular traffic as required by the Contract Documents, the Contractor's sequence of construction, and as directed by the Owner's Representative.

B. In all sheeting, shoring and bracing operations, care shall be taken to prevent collapse of excavations, injury to persons or damage to adjacent structures, facilities, utilities, and services. Any injuries to persons shall be the responsibility of the Contractor; and any damage to the work occurring as a result of settlement, water or earth pressure, or other causes due to inadequate bracing or other construction operations of the Contractor shall be satisfactorily repaired and made good by the Contractor, at no additional cost to the Owner.

C. The excavation support system shall be of sufficient strength and be provided with adequate bracing to support all loads to which it will be subjected. The excavation support system shall be designed to prevent any movement of earth that would diminish the width of the excavation or damage or endanger adjacent structures.

D. Where sheeting is to be used, it shall be driven ahead of excavation operations to the extent practicable so as to avoid the loss of material from behind the sheeting; where voids occur outside of the sheeting, they shall be filled immediately with ordinary fill, thoroughly compacted.

E. The Contractor shall leave in place all sheeting and bracing at the locations and within the limits ordered by the Owner's Representative in writing. The Contractor shall cut off the sheeting at elevations as indicated on the Contract Drawings or to be determined with the approval of the Owner's Representative.

F. The Contractor shall comply with all federal, state, and local safety regulations, and requirements.

1.8 DEWATERING

A. The Contractor shall provide, at his own expense, adequate pumping and drainage facilities to maintain the excavated area sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction procedures nor cause excessive disturbance of underlying natural ground. The flows of all water resulting from pumping shall be managed so as not to cause erosion, siltation of drainage systems, or damage to adjacent property.

B. Any damage resulting from the failure of the dewatering operations of the Contractor, and any damage resulting from the failure of the Contractor to maintain all the areas of work in a suitable dry condition, shall be repaired by the Contractor, as directed by the Owner's Representative and/or the Designer, at no additional cost to the Owner. The Contractor's pumping and dewatering operations shall be carried out in such a manner as to prevent damage to the Contract work and so that no loss of ground will result from these operations. Precautions shall be taken to protect new work from flooding during storms or from other causes. Pumping shall be continuous to protect the work and/or to maintain satisfactory progress.

C. All pipelines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected. Water from the trenches, excavations, and stormwater management operations shall be disposed of in such a manner as to avoid public nuisance, injury to public health or the environment, damage to public or private property, or damage to the work completed or in progress.

D. The Contractor shall control the grading in the areas surrounding all excavations so that the surface of the ground will be properly sloped to prevent water from running into the excavated area. Where required, temporary ditches shall be provided to control drainage. Upon completion of the work and when directed, all areas shall be restored by the Contractor in a satisfactory manner and as directed.

E. Remove dewatering system when no longer required for construction.

F. The Contractor shall obtain and maintain all required local, state, and federal permits necessary for construction dewatering for the duration of dewatering activities including all chemical testing required for disposal and discharge of dewatering effluent. The Contractor shall be responsible for treatment of water, if necessary, to meet minimum discharge criteria specified in the permits.

1.9 QUALITY CONTROL

A. Inspection and testing will be performed by the Contractor to ensure that the materials placed meet the requirements in this section. Fill materials imported from off-site sources shall be chemically and geotechnically tested once for every 2,000 tons of material.

B. If fill soils are not obtained from a commercial gravel pit, the Contractor shall provide certified analytical testing of offsite backfill to demonstrate that the soil does not exceed the limitations for MCP reference/reportable concentrations. Analyses shall include RCRA-8 metals, Extractable and Volatile Petroleum Hydrocarbons (EPH/VPH), and Volatile Organic Compounds (by EPA Method 8260B/5035). No testing will be required of imported fill soils obtained from a commercial gravel pit, provided the soils are free of odors, discoloration, staining or other conditions indicative of contamination, in the opinion of the Geotechnical Engineer and/or the Designer.

C. Tests and analysis of soil material will be performed in accordance with ASTM D422, ASTM D1557, ASTM D2922, ASTM D3017 and ASTM D4318.

D. If tests indicate materials do not meet specified requirements, the Contractor shall identify an alternative borrow source, test the new material, and submit results to the Designer at no cost to Owner.

1.10 LAYOUT AND GRADES

A. The Contractor is responsible for establishing vertical and horizontal control for the work and shall establish permanent bench marks and replace as directed any that are destroyed or disturbed. The Contractor shall maintain sufficient reference points at all times during construction to properly perform site grading. The existing survey benchmark shall be protected throughout the construction project.

B. Finished grades, contours, and elevations indicated on the Drawings describe final surface elevation for completed construction. The words “finished grade” 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 shall be given uniform slope between points and existing established grades.

1.11 QUALITY ASSURANCE

A. Field inspection and testing may be performed by a Geotechnical Engineer at the Owner’s expense to supplement the Contractor’s Quality Control testing. Classification of all materials will be made by the Geotechnical Engineer whose decision shall be final and binding on the Contractor.

B. The Contractor shall be responsible for managing and tracking all materials excavated and placed in stockpiles for testing.

C. Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. The Contractor is responsible for the adequacy of the dewatering systems.

1. The dewatering systems shall be capable of effectively reducing the hydrostatic pressure and lowering the groundwater levels to a minimum of 2 feet below excavation bottom, unless otherwise directed by the Designer, so that all excavation bottoms are firm and dry.

2. The dewatering system shall be capable of maintaining a dry and stable subgrade until the structures, pipes, and appurtenance to be built therein have been completed to the extent that they will not be floated or otherwise damaged.

3. The dewatering system and excavation support shall be designed so that the lowering of the groundwater level outside the excavation does not adversely affect adjacent structures, utilities or other improvements.

E. The Owner will perform in place density tests in accordance with ASTM D2922 or D3017 as the Work progresses, to determine the degree of compaction. Any corrective work required as a result of such tests, such as additional compaction, or a decrease in the thickness of layers, shall be performed by the Contractor at no additional expense to Owner. In place density testing shall be made at the Contractor’s expense by a qualified geotechnical testing laboratory.

F. The Designer's duties do not include the supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Designer nor any observation and testing by the Geotechnical Engineer shall excuse the Contractor from defects discovered in his Work at that time or subsequent to the testing.

G. Contractor shall assist the Owner's Testing Laboratory in performing in-place density testing at a minimum frequency of one test per lift but no less than one test per 200 cubic yards of material placed in any one lift. Compaction testing will be performed in accordance with ASTM D1557, D2922, and D3017.

H. Subgrades shall be approved for compactness and material composition prior to placing subsequent lifts. If inspections indicate Work does not meet specified requirements, the work shall be removed, replaced, and compacted at no additional cost to Owner.

1.12 REGULATORY REQUIREMENTS

A. Comply with the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (454 CMR 10.0 et seq.). Contractors shall be familiar with the requirements of these regulations.

1. All excavations shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P), State, and local requirements. Where conflict between OSHA, State, and local regulations exists, the most stringent requirements shall apply.

B. Comply with governing EPA notification regulations before, during, and upon completion of dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Comply with all rules, regulations, laws, and ordinances of the municipality, the Commonwealth of Massachusetts, and other authorities having jurisdiction over the project site or work. All labor, materials, equipment, and services necessary to make the work comply with requirements shall be provided by the Contractor without additional cost to the Owner.

D. The Contractor shall obtain and pay for all permits and licenses required to complete the work specified herein and indicated on the Contract Drawings.

1.13 EXAMINATION OF SITE AND DOCUMENTS

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 a lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation of the site.

B. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Ordinary Borrow: Ordinary borrow shall meet the requirements of MassDOT M1.01.0. It shall be well-graded, natural inorganic soil containing no stone greater than 6 inches maximum dimension. The materials shall be free of trash, ice, snow, tree stumps, roots, and other organic and deleterious materials. It shall be free of highly plastic clays, of all materials subject to decay, or other materials that will corrode piping or metals. Ordinary borrow shall have a maximum dry density of not less than 110 pounds per cubic foot. It shall be of such a nature and character that it can be compacted to the specified densities. Topsoil shall not be considered ordinary borrow. Existing available fill materials from onsite excavations may be reused as ordinary borrow if it meets the above requirements. It shall be graded within the following limits:

U.S. Standard Sieve Size	Percent Finer by Weight
6 inch	100
No. 10	30-90
No. 40	10-70
No. 200	0-15

E. Gravel Borrow: Gravel borrow shall meet the requirements of MassDOT M1.03.0, Type B. It shall be an inert, hard, durable sand and gravel or stone soil obtained from an offsite commercial source. It shall be free of ice, snow, roots, sod, rubbish, oil, hazardous material, and other deleterious or organic matter. It shall be graded within the following limits:

U.S. Standard Sieve Size	Percent Finer by Weight
3 inch	100
½ inch	50-85
No. 4	40-75
No. 50	8-28
No. 200	0-10

F. ¾” Crushed Stone: ¾” crushed stone shall meet the requirements of MassDOT M2.01.4. It shall consist of durable crushed rock or crushed gravel stone, free of ice, snow, sand, silt, clay, loam, shale, or other deleterious or organic matter. It shall be graded within the following limits:

U.S. Standard Sieve Size	Percent Finer by Weight
1 inch	100
¾ inch	90-100
½ inch	10-50
3/8 inch	0-20
No. 4	0-5

G. 1-1/2" Crushed Stone: 1-1/2" crushed stone shall meet the requirements of MassDOT M2.01.1. It shall consist of durable crushed rock or crushed gravel stone, free of ice, snow, sand, silt, clay, loam, shale, or other deleterious or organic matter. It shall be graded within the following limits:

U.S. Standard Sieve Size	Percent Finer by Weight
2 inch	100
1-1/2 inch	95-100
1 inch	35-70
¾ inch	0-25

H. Dense Graded Crushed Stone: Dense graded crushed stone shall meet the requirements of MassDOT M2.01.7. It shall consist of a mixture of crusher-run aggregate of crushed stone mixed with natural sand and gravel soil obtained from an offsite commercial source. It shall be free of ice, snow, roots, sod, rubbish, soil, hazardous material, and other deleterious or organic matter. It shall be graded within the following limits:

U.S. Standard Sieve Size	Percent Finer by Weight
2 inch	100
1-½ inch	70-100
¾ inch	50-85
No. 4	30-55
No. 40	8-24
No. 200	3-10

I. Sand: Sand shall meet the requirements of MassDOT M1.04.1. It shall consist of clean inert, hard, durable grains of quartz or other hard durable rock, free from clay, organics, surface coatings, or other deleterious or organic matter. It shall be graded within the following limits:

U.S. Standard Sieve Size	Percent Finer by Weight
½ inch	100
3/8 inch	85-100
No. 4	60-100
No. 16	35-80
No. 50	10-55
No. 100	2-10

J. Dumped Riprap: Stone used for dumped riprap shall be hard, durable, angular in shape stones, resistant to weathering and shall meet the gradation requirement specified. Neither breadth nor thickness of a single stone should be less than one-third its length. Rounded stone or boulders will not be accepted unless authorized by the Engineer. Each load of riprap shall be reasonably well graded from the smallest to the maximum size specified. Stone

shall be free from overburden, spoil, shale, and organic material and shall conform to the following gradation with no more than 5% by weight passing a 2-inch sieve:

Weight of Stone (lbs.)	Percent Finer by Weight
400	100
300	50
200	30
25	10

K. Stone for Pipe Ends: Stone for pipe ends shall be sound, curable rock which is angular in shape. Rounded stones, boulders, sandstone or similar stone or relatively thin slabs will not be acceptable. Each stone shall weigh not less than 50 pounds not more than 125 pounds and at least 75% of the volume shall consist of stones weighing not less than 75 pounds each. The remainder of the stones shall be so graded that when placed with the larger stones the entire mass will be compact.

L. Controlled Density Fill (CDF) shall be a cement concrete backfill material that flows like a liquid, supports like a solid when cured, and levels without tamping or vibrating to reach 100 percent compaction. CDF shall meet the requirements of MassDOT Specifications M4.08.00 for Type 1E (Very Flowable, Excavatable) or type 2E (Flowable, Excavatable) CDF. The mix formulation will be submitted to the Designer for review prior to placement of the material in the project.

M. Reuse of Excavated Rock: Excavated on-site rock materials processed by the Contractor meeting the gradation limits for ¾" Crushed Stone, 1-1/2" Crushed Stone, Dense Graded Crushed Stone, and Stone for Pipe Ends contained herein may be segregated and reused as approved by the Owner.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Elongation: 50% minimum; ASTM D 4632
3. Grab Tensile Strength: 160 lbs.; ASTM D 4632.
4. Trapezoid Tear Strength: 60 lbs.; ASTM D 4533.
5. CBR Puncture Strength: 410 lbs.; ASTM D 6241
6. Apparent Opening Size: No. 70 sieve maximum; ASTM D 4751.
7. Permittivity: 1.50 sec-1 minimum; ASTM D 4491
8. UV Stability: 70% after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 1; AASHTO M 288.

2. Elongation: 15% maximum; ASTM D 4632

3. Grab Tensile Strength: 315 lbs.; ASTM D 4632.

4. Trapezoidal Tear Strength: 120 lbs.; ASTM D 4533.

5. Puncture Strength: 1,000 lbs.; ASTM D 6241.

6. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.

7. Permittivity: 0.05 sec-1 minimum; ASTM D 4491.

8. UV Stability: 70% after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

A. Detectable Underground Warning Tapes: Acid and alkali-resistant polyethylene plastic film warning tape, 6-inches wide by 4-mils minimum thickness, with continuously printed caption in black letters "CAUTION - xxxxx LINE BURIED BELOW." The text and color of the tape shall be as shown in the table below. The tape shall have a metallic core encased in a protective jacket for corrosion protection and be detectable by a metal detector when the tape is buried up to 2.5-feet deep.

Color	Utility
Safety Red	Electric
High Visibility Safety Yellow	Gas, Oil, Steam
Safety Alert Orange	Telephone, Communications, Cable Television
Safety Precaution Blue	Water System, Irrigation
Safety Green	Sanitary Sewer, Storm Sewer
White	Proposed Excavation

2.4 USES OF MATERIALS

A. Fill materials listed in Paragraph 2.1 above shall be utilized as follows and as otherwise indicated on the Drawings, specified or directed.

B. Gravel Borrow:

1. As fill and base coarse soils below cement concrete and hot-mix asphalt pavements as shown on the Contract Drawings.

2. Trench backfill within paved areas.

3. Bedding for ductile iron drain, water, and sewer piping.

C. Dense Graded Crushed Stone:

1. As base course soils below cement concrete and hot-mix asphalt pavement as shown on the Contract Drawings.

D. ¾-inch and 1-1/2-inch Crushed Stone:

1. Base for drain manholes, catch basins, sewer manholes, and utility structures.

2. Bedding for drain pipe and sewer pipe.

3. Around perforated drain lines.

4. To stabilize wet subgrade conditions.

5. Elsewhere as shown on the Drawings or specified herein.

6. To aid in dewatering.

E. Sand:

1. Bedding for drain, water, sewer, and other utility piping.

2. Elsewhere as shown on the Drawings or specified herein.

F. Ordinary Borrow:

1. For general site fill outside of the proposed building footprint, concrete, and bituminous concrete areas.

2. Trench backfill material outside of paved areas.

3. Elsewhere as shown on the Drawings or specified herein.

G. Geotextiles:

1. Subsurface non-woven Drainage Geotextile shall fully wrap 3-4-inch Crushed Stone.

2. Use to prevent soil intrusion into drains and/or to assist in stabilizing soil subgrades prior to placement of fill materials.

3. Subsurface woven separation geotextile as separation material between crushed stone and gravel borrow base materials below cement concrete and hot-mix asphalt pavement as shown on the Contract Drawings.

4. Where indicated or shown in the Contract Drawings.

H. Controlled Density Fill (CDF):

1. CDF shall be used as shown on the Contract Drawings.

2. CDF shall be used if directed by the DESIGNER as fill at the limits of the excavation areas.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contract Drawings indicate the proposed finish alignment, elevation, and grade of the work. Establish the line and grade in close conformity with the Contract Drawings.

B. The Contractor is responsible for establishing construction phasing, means, and methods and interim grading and temporary conditions required to attain the finish product required by the Contract Documents. The Contractor is responsible for all construction, protection, movement, and maintenance of stockpiles. Establish and maintain suitable benchmarks and grade control to accurately perform the work.

C. No excavation shall be deposited or stockpiled at any time to endanger portions of new or existing structures, either by direct pressure or indirectly by overloading banks contiguous to the operation. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of the construction. If there is not sufficient area available for stockpiling within the limits of the project, the Contractor will be required to furnish his own area for stockpiling.

D. When the plans require excavation in areas in close proximity to existing buildings, roads, structures and utilities it shall be the responsibility of the Contractor at his expense to use satisfactory means and methods to protect and maintain the stability of such roads, and structures located immediately adjacent to but outside the limits of excavations.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 311000 - SITE CLEARING.

C. Protect and maintain erosion and sedimentation controls, which are specified in Section 312500 – EROSION AND SEDIMENTATION CONTROLS, during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.3 DEWATERING

A. Provide Dewatering as required to maintain dry excavations.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3. Where soil has been softened or eroded by flooding, equipment, traffic or placement of fill or concrete during unfavorable weather or such other conditions, it shall be removed and replaced by the Contractor with suitable material and at the Contractor's expense. The necessity and extent of such removals shall be determined by the Designer.

D. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

E. Monitor dewatering systems continuously.

F. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.

2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

G. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

H. 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 foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

I. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.

J. 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 and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

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 the Owner.

1. 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.

L. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.4 EXCAVATION SUPPORT AND PROTECTION

A. Work shall not be started until all materials and equipment necessary for the construction are either on the site of the work or satisfactorily available for immediate use as required.

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support and protect utilities encountered.

C. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner's Representative and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

D. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces or installation of improvements is not impeded.

E. The excavation support and protection systems shall be securely and satisfactorily braced to withstand all pressures wo which it may be subjected and be sufficiently tight to minimize lowering of the groundwater level outside the excavation.

F. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

G. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

H. Responsibility for the satisfactory construction and maintenance of the excavation support system, complete in place, shall rest with the Contractor. Any work done, including incidental construction, which is not acceptable for the intended purposed shall be either repaired or removed and reconstructed by the Contractor at his expense

I. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.

2. Fill voids immediately with approved backfill compacted to density specified herein.

3. Repair or replace, as approved by Owner's Representative, adjacent work damaged or displaced by the installation, performance, and removal of the excavation support and protection systems.

3.5 ROCK EXCAVATION

A. See Section 312316, Rock Removal for rock excavation and handling requirements.

3.6 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms.

b. 6 inches outside of minimum required dimensions of concrete cast against grade.

c. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

B. Provide sheeting, shoring and bracing to complete and protect all excavated areas, are required for safety and compliance with OSHA. Cost for sheeting, shoring and bracing shall be included as a part of the contract price for completing the work and Owner shall make no separate payment for this work.

C. Perform excavation work in accordance with all applicable Federal, State, and Local regulations regarding safe excavation work.

D. Excavation in the area of existing utilities. Expose utilities by hand or other excavation methods that will prevent damage. Required excavation near electric, gas, water lines, and fiber-optic telecommunication lines shall be hand dug within 3 feet of the lines.

E. Do not excavate to full depths when freezing temperatures may be expected unless subgrades are protected from freezing.

3.7 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.

1. Excavation for Underground Tanks, Manholes, Basins, Mechanical and/or Electrical Utility Structures, Drainage and Sewer Systems, Infiltration Systems, and 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.

3.8 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.9 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.10 SUBGRADE INSPECTION

A. Notify the Owner's Representative when excavations have reached required subgrade.

B. If the Owner's Representative, Geotechnical Engineer and/or the Designer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll granular subgrade below structures and pavements with heavy vibrating drum roller 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. Limit vehicle speed to 3 mph.

2. Proof-roll with approved equipment weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Designer, 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 Geotechnical Engineer and/or the Designer, without additional compensation.

E. Protect all subgrades from disturbance.

1. Place Gravel Borrow or Crushed Stone wrapped in non-woven geotextile over clayey, silty or wet footing subgrades. Fill shall not be placed in standing water.

2. Grade around prepared subgrade areas to direct stormwater runoff away from the work area.

3. Protect subgrades from frost at all times during construction. Fill should not be placed over frozen soil.

3.11 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavations under site improvement construction or utility pipe as directed by Designer. Lean concrete fill, with 28-day compressive strength of 2500 psi may be used when approved by Designer.

3.12 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials (from off-site sources) 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. Do not store within drip line of remaining trees.

2. Stockpile soil materials in a location, acceptable to the Owner's Representative, that will preclude having to relocate stockpiled soil materials that would otherwise delay or impact the Work.

3.13 BACKFILL

A. 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. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on previously placed and compacted fill and/or subgrades free of mud, frost, snow, or ice.

C. Excavated on-site natural soils may be used as Ordinary Fill, provided the material can be placed and compacted as required herein and at the approval of the Designer.

D. The Contractor shall not commence backfilling operations without approval of the Owner's Representative and/or the Designer.

E. The Contractor shall maintain a dry and firm subgrade throughout construction. Dewatering shall be performed as needed at the Contractor's expense.

F. The Contractor shall strip the existing subgrade of any vegetation, topsoil, organics, debris, or other unsuitable materials. The subgrade shall be proof compacted using a vibratory roller to treat any lose or disturbed areas and to provide a dense uniform surface.

G. After the subgrade has been prepared, fill material shall be placed and built-up in successive layers until the required elevations are reached. No fill shall be placed on a frozen surface, nor shall snow, ice, or other frozen materials be included in fill. Wet materials containing moisture in excess of the amount necessary for satisfactory placement or compaction shall not be used.

H. All fill shall be brought up in essentially level lifts and shall be placed in levels by standard methods. Layers of fill outside of utility trenches shall not exceed nine (9) inches in uncompacted thickness before compaction, unless otherwise specified, or as required for proper subgrade stabilization.

I. Filling operations shall continue until the fill has been brought up to the finished slopes, lines, and grades making proper allowances for thickness of the overlying topsoil.

J. The entire surface of the work shall be maintained free from ruts and in the condition that will permit construction equipment to travel over any section readily. The top surface of each layer shall be made level or slightly sloped toward the center of the filled area.

K. Backfilling shall not be performed when weather conditions or the conditions of the materials are such that, in the opinion of the Geotechnical Engineer or the Designer, work cannot be performed satisfactorily.

3.14 BACKFILLING AGAINST STRUCTURES

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Backfilling against masonry or concrete shall not be done until permitted by the Owner's Representative. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking or other damage.

C. As soon as practicable after the structures are structurally adequate and other necessary work has been satisfactorily completed and approved, special leakage tests of the structures shall be made by the Contractor, as required by the Owner's Representative. After the satisfactory completion of leakage tests and the satisfactory completion of any other required work in connection with the structures, the backfilling around the structures shall proceed using suitable and approved excavation material.

D. The best of the backfill material shall be used for backfilling within 2-feet of the structure. Just prior to placing backfill, the areas shall be cleaned of all excess construction material and debris and the bottom of excavations shall be in a thoroughly compacted condition.

E. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures. During backfilling operations, care shall be exercised that the equipment used will not overload the structures in passing over and compacting these fills. Except as otherwise specified or directed, backfill shall be placed in layers not more than 12 inches in loose depth and each layer of backfill

shall be compacted thoroughly and evenly using approved types of mechanical equipment. Each pass of the equipment shall cover the entire area of each layer of backfill.

F. In compacting and other operations, the Contractor shall conduct his operations in a manner to prevent damage to structures due to passage of heavy equipment over, or adjacent to, structures, and any damage thereto shall be made good by the Contractor at no additional expense to the Owner.

3.15 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 - CAST-IN-PLACE CONCRETE.

D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

E. Place and compact initial backfill of subbase material free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

G. Backfill material shall be placed in maximum 6-inch lifts and mechanically competed as specified herein.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

J. Any trenches or excavations improperly backfilled or where settlement occurs shall be reopened, to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition, at no additional expense to the Owner.

K. During filling and backfilling operations, pipelines will be checked by the Owner's Representative to determine whether any displacement of the pipe has occurred. If the observation of the pipelines shows poor alignment, displaced pipe or any other defects they shall be remedied in a manner satisfactory to the Owner's Representative at no additional cost to the Owner.

3.16 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

C. Place soil fills on subgrades free of mud, frost, snow, or ice.

3.17 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. Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.

3.18 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

Area	ASTM Density Degree of Compaction
Pavement and walkway base course	95%
Pavement and walkway subgrade	95%
General fill below pavement and walkway subbase	95%
Trench backfill - below pavements - below landscaped areas	95% 92%

Area	ASTM Density Degree of Compaction
- below structures	95%
All other areas	90%

1. Under structures and pavement, proof-compact existing subgrade. Compact each layer of backfill soil material at 95 percent of the soils' maximum dry density (per ASTM D 1557). Fill areas within the 1H:1V influence zone of foundations and retaining wall footings shall also be compacted to 95 percent of the soils' maximum dry density (per ASTM D 1557).

2. Under walkways, scarify and re-compact top 6 inches below subgrade to 95 percent of the soils' maximum dry density (per ASTM D 1557). Fill and base course material within 2 feet of the finished asphalt or concrete pavement grade shall be compacted to 95 percent of the soils' maximum dry density (per ASTM D 1557).

3. For utility trenches in paved areas, compact each layer of initial and final backfill soil material to at least 95 percent of the soils' maximum dry density (per ASTM D 1557).

4. For utility trenched in lawn or unpaved areas, compact each layer of backfill soil material to at least 92 percent of the soils' maximum dry density (per ASTM D 1557).

5. Under lawn or unpaved areas, scarify and re-compact top 6 inches below subgrade and compact each layer of backfill or fill soil material to at least 90 percent of the soils' maximum dry density (per ASTM D 1557).

D. In confined areas, place Crushed Stone in maximum 6-inch lifts and compact each lift with at least 4 passes of a vibratory plate compactor to a firm and unyielding surface. In open areas, place Crushed Stone in maximum 12-inch lifts and compact each lift with at least four passes of a vibratory drum roller with a minimum static weight of 10,000 pounds. Crushed stone fill shall be wrapped on all sides with non-woven filter fabric.

3.19 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1 inch.

3. Pavements: Plus or minus 1/2 inch.

3.20 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 2 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 1557.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 1557.

2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade.

3.21 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Install separation geotextile fabric on prepared subgrade, where indicated on the Contract Drawings, according to manufacturer's written instructions, overlapping sides and ends.

2. Place base course material over subbase course under hot-mix asphalt pavement.

3. Shape subbase and base course to required crown elevations and cross-slope grades.

4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.

5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.22 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under pavements, walkways and cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.23 FIELD QUALITY CONTROL

A. Independent Testing Agency: Cooperate with the Independent Testing Agency engaged by the Owner for field quality control activities for the Work of this Section. Refer also to Section 014325 - TESTING AGENCY SERVICES.

B. Cooperate with field quality control personnel.

C. Additional inspections and retesting of materials which fail to comply with specified material and installation requirements shall be performed at Contractor's expense.

D. 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.

E. 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. Paved 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.

2. 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.

F. 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. Costs related to retesting due to unacceptable quality of work and failures discovered by the testing shall be borne by the Contractor.

G. Notify the Independent Testing Agency a minimum of 72 hours prior to start of earthwork operations, to comply with Code requirement that a registered design professional be present at all times during backfill to assure adequate compaction with no bridging effects. The services of the Testing Agency, Geotechnical Engineer, and the Designer shall include but not be limited to the following:

1. Observation during excavation, backfilling, and compaction.

2. Laboratory testing and analysis of fill materials specified or proposed for use as required.

3. Observation of construction and performance of water content, gradation, and compactions tests at a frequency and at locations that he/she shall selects. The results of these test will be submitted to the Owner's Representative so that the Contractor can take such action as is required to remedy any indicated deficiencies.

4. Observation of proof-compaction of exposed subgrades. Proof-compaction may be waived if, in the opinion of the Geotechnical Engineer, disturbance will occur and cause loss of strength of underlying soil.

H. The Contractor shall make provisions for allowing observations and testing of Contractor's Work by the Testing Agency and the Geotechnical Engineer, and the Designer. The presence of the Testing Agency, Geotechnical Engineering, and/or the Designer does not include supervision or direction of the actual work by the Contractor, his/her employees, or agents. Neither the presence of the Testing Agency, Geotechnical Engineer, and/or the Designer nor any observations and testing performed by those entities or any notice or failure to give notice, shall excuse the Contractor from defect discovered in his/her work.

3.24 PROTECTION

A. No excavation will be permitted below a line drawn downwards at 2 horizontal to 1 vertical from the underside of the closest edge of any proposed in-place footing or utility at a higher elevation without providing adequate sheeting and bracing or underpinning to prevent loss of support of the footing or utility.

B. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

C. Repair and reestablish grades to specified 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 Designer; reshape and recompact.

D. Where settling occurs before Project correction period elapses, 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.

3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Contractor shall remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

SECTION 312500

EROSION AND SEDIMENTATION 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. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Control measures to prevent all erosion, siltation, and sedimentation of wetlands, waterways, construction areas, adjacent areas and off-site areas.

2. Control measures shall be accomplished adjacent to or in the following work areas:

a. Soil stockpiles and on-site storage and staging areas.

b. Cut and fill slopes and other stripped and graded areas.

c. Constructed and existing swales and ditches.

d. Retention ponds.

e. At edge of wetlands areas, if applicable, as shown on Drawings.

3. The Contract Drawings indicate the minimum requirements for sedimentation and erosion control. The Contractor shall install all measures needed to control sediment and erosion as required by the Contractor and Sub-contractor's construction methods and operations, the weather conditions, and as directed by the Engineer.

4. Additional means of protection shall be provided by the Contractor as required for continued or unforeseen erosion problems, at no additional cost to the Owner.

5. Periodic maintenance of all sediment control structures shall be provided to ensure intended purpose is accomplished. Sediment control measures shall be in working condition at the end of each day.

6. After any significant rainfall, sediment control structures shall be inspected for integrity. Any damaged device shall be corrected immediately.

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 will be performed under the designated Sections:

1. Section 311000 – SITE CLEARING for protection of existing trees and other vegetation to remain.

2. Section 312000 – EARTH MOVING for soil materials, excavating, backfilling, and site grading and removal of site utilities.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. At least 20 days prior to the start of the project, the Contractor shall submit an Appendix by a qualified person to the Draft Stormwater Pollution Prevention Plan (SWPPP) indicating project phasing, Contractor operation areas, work areas, stockpile locations, construction staging/sequencing, and sedimentation and erosion control measures to be used. This Appendix shall become part of the SWPPP that is to be updated and maintained by the Contractor.

2. As part of the Contract Closeout procedures, the Contractor is responsible for filing a Notice of Termination with the EPA once the project has been completed and is permanently stabilized. Stabilization is complete when all temporary storm water and erosion controls have been removed, all permanent storm water and erosion controls are in place and functional and all vegetated areas are at least 70% viable.

3. The Contractor shall provide the manufacturer's literature, material specification, and installation instructions for sedimentation and erosion control materials and devices for approval. Do not order materials until approval of certifications or test results has been obtained. Delivered materials shall match the approved submittals.

4. LEED Supporting Documentation (if required): Submit LEED supporting documentation as outlined in Section 018110 SUSTAINABLE DESIGN REQUIREMENTS for materials and products that have been extracted, harvested, or recovered, as well as manufactured within 500 miles of the project site.

1.4 QUALITY ASSURANCE

A. When applicable, comply with the requirements of Stormwater Pollution Prevention Plan prepared for the NPDES permit, which are incorporated herein by reference, and all other applicable requirements of governing authorities having jurisdiction. The specifications and drawings are not represented as being comprehensive, but rather convey the intent to provide complete slope protection and erosion control for both the project site and adjacent property.

1. 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 a sediment and erosion control plan specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Erosion control measures shall be established at the beginning of construction and maintained during the entire period of construction. On-site areas which are subject to severe erosion, and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation, are to be identified and receive special attention.

C. The Contractor shall install and maintain sedimentation control devices during construction to prevent the movement of sediment from the construction site to off site areas, into adjacent water bodies via surface runoff or into underground drainage systems. Measures to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at no additional cost to the Owner.

D. All land-disturbing activities are to be planned and conducted to minimize the size of the area to be exposed at any one time, and the length of time of exposure.

E. Surface water runoff originating upgrade of exposed areas should be controlled to reduce erosion and sediment loss during the period of exposure.

F. When the increase in the peak rates and velocity of storm water runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving stream bed, provide measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream.

G. All land-disturbing activities are to be planned and conducted so as to minimize off-site sedimentation damage.

H. The Contractor is responsible for cleaning out and disposing of all sediment once the storage capacity of the sediment facility is reduced by one-half.

I. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

J. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

1.5 REFERENCE STANDARDS

A. The following standards are applicable to the work of this Section to the extent referenced herein:

1. “Massachusetts Erosion and Sedimentation Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers and Municipal Officials”, prepared by the Massachusetts Department of Environmental Protection, Bureau of Resource Protection, dated March 1997, reprinted May 2003.

1.6 EXAMINATION OF SITE AND DOCUMENTS

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 a lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation of the site.

B. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

1.7 PERMITS, CODES, AND REGULATIONS

A. Comply with all rules, regulations, laws, and ordinances of the City and State, and all other authorities having jurisdiction over the project site. All labor, materials, equipment, and services necessary to make the work comply with such requirements shall be provided by the Contractor without additional cost to the Owner.

B. Comply with all applicable regulations of the Commonwealth of Massachusetts Department of Environmental Protection (DEP) and the EPA.

C. The Contractor shall comply with the requirements of the NPDES CGP for this project.

1.8 STORM WATER POLLUTION PREVENTION PLAN

A. A professional engineer has prepared a Draft Storm Water Pollution Prevention Plan (SWPPP). The Contractor shall locate the SWPPP and review its contents thoroughly. Upon the award of the Contract, the Contractor becomes responsible for implementing the SWPPP and meeting the requirements and standards detailed within the SWPPP. The Contractor is also responsible for all record keeping associated with maintaining the SWPPP and for maintaining in good operating condition all SWPPP controls. The Contractor shall modify the SWPPP as necessary to reflect changes in project scope, schedule, or approach. All labor, materials, equipment, and services necessary to make the work comply with such requirements shall be provided by the Contractor without additional cost to the Owner.

B. The Contractor shall fill out all pertinent information within the SWPPP.

C. The Contractor shall locate the EPA “Notice of Intent for Storm Water Discharges Associated with CONSTRUCTION ACTIVITY Under a NPDES General Permit” (NOI) form in the SWPPP. The Contractor is responsible for signing and filing his copy of the NOI at least 14 calendar days prior to the start of any construction activity and placing a signed copy along with proof of mailing in the SWPPP.

D. The Contractor is responsible for obtaining a copy of the Owner’s filed copy of the NOI form and proof of mailing and placing it in the SWPPP.

E. The Contractor is responsible for filling in the Contractor and Sub-Contractor information in the areas indicated within the SWPPP and for completing the Contractor’s Certification portion of the SWPPP.

F. The Contractor is responsible for maintaining the following records on site:

1. Completed SWPPP as indicated in sections B, C, D, and E.

2. Completed Inspection Reports

3. Completed Maintenance Reports

4. Construction Activity Reports

5. Spill Records

6. Other Materials relevant to the NOI Permit and SWPPP

7. A copy of the Notice of Termination

G. The Contractor is responsible for filing a Notice of Termination once the project has been completed and is permanently stabilized. Stabilization is complete when all temporary storm water and erosion controls have been removed, all permanent storm water and erosion controls are in place and functional and all vegetated areas are at least 70% viable.

H. All labor, materials, equipment, and services necessary to make the work comply with the above requirements shall be provided by the Contractor without additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Straw Bales: Wire or nylon bound bales of straw, oriented around sides, rather than over and under.

B. Stakes: Stakes for bales shall be one of the following materials: Wood stakes of sound hardwood 2 by 2 inches in size or steel reinforcing bars of at least No. 4 size. Lengths shall be approximately three feet.

C. Straw Wattles

1. Straw wattles shall consist of weed free rice straw inside biodegradable netting. Straw wattles shall measure at least nine (9) inches in diameter.

2. Stakes for wattles shall be one of the following materials. Lengths shall be approximately two feet (2').

a. Wood stakes of sound hardwood, one inch by one inch (1" x 1") in size.

b. Steel reinforcing bars of at least No. 4 size.

D. Siltation Fence

1. Fabricated or prefabricated unit consisting of the following filter fabric properties:

a.	Grab Tensile Strength (lbs)	124	ASTM D4632
b.	Elongation at Failure (%)	15	ASTM D4632
c.	Mullen Burst Strength (PSI)	280-300	ASTM D3786
d.	Puncture Strength (lbs)	60-65	ASTM D4833
e.	Water Flow Rate (gal/min/sf)	8-10	ASTM D4491
f.	Apparent Opening Size (Sieve)	30	ASTM D4751
g.	Ultraviolet Radiation Stability (%)	70-80	ASTM D4355

2. Use only commercially available fabric that is certified in writing by the manufacturer for the purpose intended.

3. Acceptable fabric materials include "Mirafi Envirofence” by Mirafi Construction Products, "Style 2130" by Amoco Fabrics Co., and “IVI 3617C Silt Fence” by Indian Valley Industries, Inc., or approved equal by the Engineer.

4. Silt fence posts: Posts may be wood or metal. Wood post shall be a minimum 1¼ inch by 1¼ inch by 5 feet long hardwood stakes commonly used to support siltation fabric. Metal posts shall be a minimum of 1 inch wide and 5 feet long. Posts shall be spaced at a maximum distance of 8 feet on center.

5. Provide suitable heavy nylon cord for securing abutting silt fence posts.

E. Fencing: Steel posts shall be standard 6-foot long metal stamped drive stakes commonly used to support snow fences. Fencing shall be new four-foot height wood lath snow fencing. Provide suitable steel staples or heavy nylon cord for securing filter cloth to support system.

F. Crushed Stone: Crushed Stone: Crushed stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, sand, clay, loam, or other deleterious or organic material. The crushed stone shall be uniformly blended and shall conform to the following requirements.

Percent Passing by Weight		
Sieve Size	**1 1/2-inch Stone**	**3/4-inch Stone**
2-inch	100	---
1 1/2-inch	95-100	---
1 1/4-inch	---	---
1-inch	35-70	100
3/4-inch	0-25	90-100
1/2-inch	---	10-50
3/8-inch	---	0-20
No. 4	---	0-5

G. Protective Measures: As temporary coverings on ground areas subject to erosion, provide one of the following protective measures, and as directed by the Designer with concurrence of the Owner's Representative:

1. Hay or straw temporary mulch, 100 pounds per 1,000 square feet.

2. Wood fiber cellulose temporary mulch, 35 pounds per 1,000 square feet.

3. Tackifier for anchoring mulch or straw shall be a non-petroleum based liquid bonding agent specifically made for anchoring hay or straw.

4. Provide natural (jute, wood excelsior) or man-made (glass fiber) covering with suitable staples or anchors to secure to ground surface. Note that wire staples and non-biodegradable coverings shall not be used for any area that will be mown turf.

5. Temporary vegetative cover for graded areas shall be undamaged, air dry threshed straw or hay free of undesirable weed seed.

H. Temporary Covers for Drainage Structures

1. Filter fabric for use as temporary covers for drainage structures shall be the same as noted above for siltation fence.

2. Wire mesh for use at temporary drainage structure covers shall be 6" x 6", W2.9 welded wire mesh.

3. Crushed stone shall be as specified herein before.

4. Silt-Sac, Hydro-FloGard + Plus Catch Basin Insert, Ultra-DrainGuard Insert, or approved equal, may be used in lieu of hay bales and filter fabric at catch basins.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contractor shall provide suitable and adequate means of sedimentation and erosion control during construction. Control measures shall prevent all erosion, siltation, and sedimentation of waterways, drainage systems, construction areas, adjacent areas and off-site areas. Work shall be accomplished on and/or adjacent to the following work areas:

1. Earthwork stockpiles and on-site storage and staging areas.

2. Cut and fill slopes and other stripped and exposed graded areas.

3. Constructed and existing swales and ditches.

4. Unestablished lawns and seeded embankments.

B. Means of protection as noted on the Contract Drawings indicate the minimum provisions necessary. Additional means of protection shall be provided by the Contractor as required for continued or unforeseen erosion problems, at no additional expense to the Owner.

C. Periodic maintenance of all sediment control installations shall be provided to ensure intended purposes are accomplished. Sediment control measures shall be in working condition at the end of each day.

D. After any significant rainfall, sediment control devices shall be inspected for integrity. Any damaged device shall be corrected immediately.

E. The Contractor shall provide adequate means of control of runoff, as to not detrimentally impact downstream conditions during construction. The Contractor shall plan his operations so that permanent drainage mitigation systems such as detention/retention/infiltration basins and chambers are in place and properly functioning prior to connecting upland drainage flows to these systems. The Contractor shall plan his operations such that downstream drainage mitigation measures are in place and functioning before attempting to tie in upgradient drainage systems.

F. In the event that the Contractor is unable to sequence the work so that construction of the permanent drainage mitigation systems precedes the upland work, then the Contractor shall submit a plan indicating his proposed methods of otherwise controlling runoff from the site.

G. The "Massachusetts Erosion and Sedimentation Control Guidelines for Urban and Suburban Areas" should be consulted as a guide for the selection and installation of Best Management Practices to suit the conditions encountered.

3.2 STRAW BALE BARRIERS

A. Excavation shall be to the width of the bale and the length of the proposed barrier to a minimum depth of 4 inches.

B. Bales shall be placed in a single row, lengthwise on proposed line, with ends of adjacent bales tightly abutting one another. In swales and ditches, the barrier shall extend to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale.

C. Staking shall be accomplished to securely anchor bales by driving at least two stakes or rebars through each bale to a minimum depth of 18 inches.

D. The gaps between bales shall be filled by wedging straw in the gaps to prevent water from escaping between the bales.

E. The excavated soil shall be backfilled against the barrier. Backfill shall conform to ground level on the downhill side and shall be built up to 4 inches on the uphill side. Loose straw shall then be scattered over the area immediately uphill from a straw barrier.

F. Inspection shall be frequent and repair or replacement shall be made promptly as needed.

G. Bales shall be removed when they have served their usefulness so as not to block or impede stormwater flows or drainage.

3.3 STRAW WATTLE BARRIERS

A. Install straw wattles in locations as shown on Contract Drawings and as directed.

1. Wattles shall be placed in a row with ends overlapping a minimum of two (2) feet.

2. Each wattle shall be embedded in the soil a minimum of two (2) and a maximum of six (6) inches.

3. Wattles shall be securely anchored in place by stakes or rebars driven through the wattles and a minimum twelve (12) inches into the soil. Stakes shall be placed four (4) feet on center.

B. Inspection shall be frequent and repair or replacement shall be made as needed.

C. Wattles shall be removed when they have served their usefulness so as not to block or impede stormwater flows or drainage.

3.4 STABILIZED CONSTRUCTION ENTRANCE AND STONE BERMS

A. Stone size: Use ASTM designation C-33, size No. 2 (1-1/2” to 2-1/2”). Use crushed stone.

B. Length: As effective, but not less than 50 feet.

C. Thickness: Not less than eight inches.

D. Width: Not less than full width of all points of ingress or egress, but not less than 25 feet.

E. Washing: When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public right-of-way. When washing is required, it shall be done on an area stabilized with crushed stone which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch, or watercourse through the use of sand bags, gravel boards or other approved methods.

F. Maintenance: The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spoiled, dropped, washed or tracked onto public rights-of-way must be removed immediately.

G. Place crushed stone berms in locations required and as directed. Berms shall have side slopes of 1:3 or less.

H. Inspect stone berms periodically and replace and/or regrade crushed stone as required.

3.5 SILT FENCING

A. Excavate a 6-inch trench along the upstream side of the desired fence location.

B. Drive fence posts a minimum of 1'-6" into the ground. Install fence, well-staked at maximum eight-foot intervals in locations as shown on Drawings. Secure fabric to fence and bury fabric end within the six-inch deep trench cut.

C. Lay lower 12 inches of silt fence into the trench, 6 inches deep and 6 inches wide. Backfill trench and compact.

D. Overlap joints in fabric at post to prevent leakage of silt at seam.

E. Inspect siltation fence after major storm events and periodically and remove accumulated sediment and debris. If a breach or failure of the siltation fence occurs, the fence shall immediately be restored.

3.6 EROSION CONTROL GRASSING

A. Grassing shall be applied according to the Massachusetts Erosion and Sedimentation Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers and Municipal Officials.

3.7 INLET PROTECTION

A. Install silt fence or straw bales around inlet as specified herein.

B. Install temporary covers at drainage structure locations that may be subject to erosion infiltration and as directed by the Engineer.

C. Inspect drainage structures periodically. Remove sediment accumulation and regrade or replace materials as required.

3.8 DUST CONTROL

A. Throughout the construction period the Contractor shall carry on an active program for the control of fugitive dust within all site construction zones, or areas disturbed as a result of construction. Control methods shall include the following: Apply calcium chloride at a uniform rate of one and one-half (1 ½) pounds per square yard in areas subject to blowing. For emergency control of dust apply water to affected areas. The source of supply and the method of application for water are the responsibility of the contractor.

B. The frequency and methods of application for fugitive dust control shall be as directed by the Designer with concurrence by the Owner's Representative.

3.9 TEMPORARY PROTECTIVE COVERINGS

A. Place temporary soil coverings to control erosion and sedimentation on all disturbed or graded areas as required by the construction methods employed and as directed by the Engineer. Erosion control matting shall be installed in all areas seeded or hydroseeded with slopes of one vertical foot to three-foot horizontal, or steeper, immediately after such areas have been seeded and a hay mulch applied as follows:

1. The area to receive matting shall have been recently seeded and shall have a smooth surface free front stones, clods or depressions.

2. Roll out of the matting perpendicular to the slope, do not stretch the fabric. In drainage swales, center the fabric along the flow line. Install the matting in a check slot at the top and bottom of the slope and at the edges of the area to be covered. Check slots shall be six inches deep and six inches wide. Fabric shall extend down one wall of the check slot and across the full width of the base. Overlap edges of matting rolls four (4) inches minimum and overlap the ends eighteen (18) inches minimum.

3. Install staples in check slots, edges, center, and ends of rolls by driving specified steel staples two feet on center over the entire area to be covered except at check slots and ends of rolls, where staples shall be placed six inches on center. All staples shall be driven below finished grade.

4. Fill check slots with loam and tamp firmly.

5. Reseed check slots and all disturbed areas per Specifications.

6. Following matting installation, roll the entire area with a smooth drum roller weighing between fifty and seventy-five (50-75) pounds per linear foot of roller. The finished installation of matting shall be firmly in contact with the seeded area and provide a smooth, finished appearance free from lumps or depressions.

B. Install erosion control matting as a temporary ground cover in all disturbed or graded areas subject to erosion and as directed by the Engineer. The temporary ground cover shall protect the site from erosion until a full permanent lawn can be installed. Install and anchor in place temporary erosion control matting in accordance with manufacturer's printed instructions or as directed by the Engineer and remove all temporary erosion control matting prior to installation of a permanent lawn.

C. Inspect protective coverings periodically and reset or replace materials as required.

3.10 TEMPORARY PROTECTIVE COVERINGS (AFTER GROWING SEASON)

A. Place temporary covering for erosion and sedimentation control on all areas that have been graded and left exposed after October 30. Contractor shall have the choice to use either or both of the methods described herein.

B. Hay or straw shall be anchored in-place by one of the following methods and as approved by the Designer with concurrence by the Owner’s Representative: Mechanical “crimping” with a tractor drawn device specifically devised to cut mulch into top two inches of soil surface or application of non-petroleum based liquid tackifier, applied at a rate and in accordance with manufacturer’s instructions for specific mulch material utilized.

C. Placement of mesh or blanket matting and anchoring in place shall be in accordance with manufacturer’s printed instructions.

D. Inspect protective coverings periodically and reset or replace materials as required.

3.11 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized against erosion, and with the approval of the Owner’s Representative remove sediment control devices and all accumulated silt. Dispose of silt and

waste materials offsite. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated.

END OF SECTION

SECTION 321216

ASPHALT PAVING

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. Hot-mix asphalt paving, including walkways, ramps, and curbs.

2. Hot-mix asphalt patching.

3. Pavement-marking paint.

4. Setting of Curb.

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 will be performed under the designated Sections:

1. Section 312000 - EARTH MOVING for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities. Submit shop drawings for curbing items.

D. Material Certificates: For each paving material, from manufacturer.

1.4 REFERENCE STANDARDS

A. The following standards are applicable to the work of this Section to the extent referenced herein:

1. Commonwealth of Massachusetts, Massachusetts Highway Department (MHD), Standard Specifications for Highways and Bridges, latest English Edition with amendments. All references to method of measurement, basis of payment and payment items in the Standard Specifications are hereby deleted. References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned herein.

2. ASTM: American Society for Testing and Materials

3. AASHTO: American Association of State Highway and Transportation Officials

4. ACI: American Concrete Institute

5. MUTCD: Manual on Uniform Traffic Control Devices

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Massachusetts Highway Department (MHD).

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Massachusetts Highway Department (MHD) for hot mix asphalt paving work.

1. Comply with requirements of the Massachusetts Highway Department (MHD) Standard Specifications for Highways and Bridges, including supplemental specifications and special provisions.

2. Comply with requirements of the Americans with Disabilities Act (ADA) and the Massachusetts Architectural Access Board (MAAB). If these requirements cannot be met with the grades and slopes indicated on the plans, notify the Designer immediately.

3. Comply with requirements of the local authority having jurisdiction concerning the location and construction of accessible curb cuts.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.

b. Review condition of subgrade and preparatory work.

c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 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.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F.

2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

C. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

1.8 EXAMINATION OF SITE AND DOCUMENTS

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 a lack of knowledge of existing conditions as indicated in the Construction Documents, or obvious from observation of the site.

B. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

1.9 ADA AND MAAB COMPLIANCE

A. Comply with American with Disabilities Act (ADA) and the requirements of the Massachusetts Architectural Access Board (MAAB).

1. Slopes: Walkways as defined by Section 22.1 of 521 CMR, shall be graded to a maximum of 4.5%. The cross-pitch (perpendicular to travel) for walkways and paths shall be constructed at 1.5%. The slopes of ramps and side slopes on handicap curb cuts as defined by Section 21.1 of 521 CMR shall be constructed at 7% maximum.

Ramps as defined in Section 24.1 of 521 CMR, shall be constructed to a maximum slope of 7%.

2. The Contractor is to assume that sidewalk grades will be verified and checked with a 2-foot long electronic 'smart level'.

3. A 5'-0" minimum level, 1.5% pitch, area shall be provided at entrances to buildings. Puddling or ponding of water at the entrances will not be accepted.

4. Handicap parking spaces and access aisles shall be graded level with the slope not to exceed 1.8% in any direction.

5. The requirements specified hereinabove shall supersede the grades indicated on the Drawings. If these requirements cannot be met with the grades indicated on the Drawings, the Designer shall be notified immediately for direction.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

D. Reclaimed Asphalt Pavement (RAP): Provide material obtained from the highways or streets by crushing, milling, or planing existing hot mix asphalt pavements.

1. The proportion of RAP to virgin aggregate for base course mixtures and intermediate course mixtures shall be limited to a maximum of 40% for drum mix plants and 20% for modified batch plants. The maximum amount of RAP for surface course mixtures shall be 10%.

E. RECLAIMED BASE COURSE

1. The work under this item shall consist of scarifying and pulverizing in place the existing asphalt pavement and underlying material, mixing and blending the material, and spreading and compacting the mixture to the lines and grades shown on the Contract Drawings.

2. Equipment such as rear-mounted ripper crushers and cold planing/milling equipment will not be permitted to perform the work under this item.

3. Prior to scarifying and pulverizing the pavement, the Contractor shall locate, protect, or remove all drainage and utility structure castings. All lowered structures shall be protected and covered by a steel plate and all watergates shall be covered as well to prevent any materials from falling into the bottom sections. All materials that fall into any structures as a result of the Contractor's operations shall be removed by the Contractor at no additional cost.

4. The existing full bituminous pavement structure and underlying base materials shall be simultaneously crushed, pulverized, and blended into a homogenous material to create the following gradation:

Sieve Designation	Percent Passing
2-inch	100
1½-inch	70-100
½-inch	50-85
No. 4	30-60
No. 50	8-28
No. 200	0-10

5. The construction operation shall be performed in such a manner as to allow for continuous vehicular access as required by the project schedule. Emergency vehicular access shall be maintained at all times.

2.2 ASPHALT MATERIALS

A. Asphalt Binder, Performance Graded: AASHTO M320 or AASHTO MP 1a, performance grade as required by MHD Specifications.

B. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Pavement-Marking Paint: Fast Drying White Water-borne Traffic Paint and Fast Drying Yellow Water-borne Traffic Paint as specified in the “Standard Specifications” under Sections M7.01.23 and M7.01.24, respectively.

1. Color: As indicated

C. Detectable Warning Panels shall have dome geometry in accordance with ADA Regulations for Detectable Warning on Curb Ramps. They shall be raised truncated domes with a nominal diameter of 0.9-inches, a nominal height of 0.2-inches, and a center-to-center spacing of 1.6 inches to 2.4-inches. Panels shall be 24-inches deep in the direction of travel and the full width of the proposed ramp. The panel shall be a homogeneous glass and carbon reinforced composite, which is colorfast, and UV stable. The panel is to be colored throughout and not a painted coating. The color is to be contrasting to the background sidewalk color. The panels shall have a compressive strength in excess of 10,000 psi, flexural strength in excess of 3,000 psi and a slip resistance in excess of 0.8 wet or dry.

D. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.4 ASPHALT MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by MHD Specifications and designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types".

2.5 ASPHALT CURB

A. Bituminous concrete curb shall conform to Section 501.64 of the Standard Specifications for Class 1 Bituminous Concrete Curb, Type-2 and Type-3 and shall meet the dimensions as shown on the Contract Drawings.

B. Bituminous concrete shall meet the requirements of Dense Mix as specified in the Standard Specifications under Section M3.12.00.

2.6 GRANITE CURB AND EDGING

A. Granite curb and edging shall be light gray in color, free of seams and other imperfections, which would affect its structural integrity. The front face of the stone shall be at right angles to the plane of the top and the ends and shall have a smooth surface. The ends of the stones shall be square with the planes of the top and front face to provide flush joints. Top surface shall be sawn cut with a split front face.

B. Granite curb shall have a top width of 6 inches and a depth of 17 to 19 inches and a minimum length of 6 feet. Granite edging shall have a thickness of 5 to 6 inches and a depth of 11 to 13 inches with a minimum length of 4 feet.

C. Granite curb to be set on a radius of 100 feet or less shall be cut to the required radius and shall have a minimum length of 6 feet or the length of the curb section, whichever is less. Granite edging set on a radius of 160 feet or less shall be supplied in lengths shorter than 6 feet but no less than 1 foot to provide a smooth appearance.

D. The ends of all transition curb shall be cut with a power-driven saw to provide a flush vertical joint with adjacent curbing

2.7 PRECAST CONCRETE CURB

A. Precast concrete curb units shall consist of castings conforming to a 6-inch by 18-inch nominal profile size with a 7-inch base dimension. Straight curb shall be cast in minimum lengths of 6 feet. Straight and curved curb may be cast in lengths of not less than 3 feet for closure sections only. Curb on a radius of 100 feet or less shall be cast in radius forms to the correct radius. The Contractor shall supply special cast corner sections for all corners where curb runs change direction. All curbs shall have a ½ inch chamfered edge on both ends and front sides as detailed. The front top edge shall have a ¾ inch radius and the back top edge shall have a ¼-inch radius.

B. Curb shall be made of Portland cement types I or III, conforming to ASTM C150. Admixtures shall meet ASTM C233. Forms shall be made of metal to tight, rigid construction with true surfaces. Wood forms are not acceptable except for cast-in-place closure sections.

C. Concrete mix for curb shall be made of a maximum ¾-inch aggregate with a design strength of 5,000 psi at 28 days. An air-entraining agent shall be added to the mixer in accurately proportioned amounts to give air content to the concrete of not less than 5 percent and not more than 7 percent by volume. A high range water-reducing agent (super plasticizer) shall

be added to the mixer in accurately proportioned amounts to meet design strength requirements and maintain a smooth, dense surface on the curb.

D. Surface Treatment: Upon removal from the forms, the surfaces of the curb shall have all surfaces rubbed with a carborundum stone to fully remove any rough or imperfections in the cast finish. All curbing sections shall have a uniform color and finish appearance and shall be approved by the Architect. An approved sample shall be standard for the entire job.

E. Curb shall be reinforced with bars conforming to ASTM A615.

2.8 SEALCOAT

A. Asphalt emulsion sealcoat shall conform to the requirements of the Asphalt Institute for seal coating. Non-volatile solids shall be 40-70%. No additional water shall be added. The emulsion shall be produced using a colloid mill to ensure homogeneity and appropriate size of the particles in suspension.

B. Sand shall be washed and graded silica sand, or crushed, washed, and graded slag, free of all contaminants, and conforming within a 40-70 mesh gradation range. The addition of sand shall target 3 lbs.−4 lbs. per gallon.

C. Sand shall be slowly added into the emulsion with the mixer engaged during the addition of the sand to ensure uniform dispersion and to prevent overloading of the mixing device. No additional water shall be added.

D. Slow mixing shall be continuous from the time all materials are placed into the mixer until the pavement sealer mix is applied to the pavement by the application equipment. During the entire mixing process, no breaking, segregating, or hardening of the emulsion, and no balling or lumping of the aggregate shall be permitted.

E. The Contractor shall submit a certified analysis of the proposed asphalt bulk emulsion, non-volatiles content, and ash content.

2.9 SEALANT FOR CRACK FILLING/SEALING

A. The sealant material shall be a hot pour elastomeric type conforming to the requirements of ASTM D 6690 Type II, together with the following modifications:

Cone Penetration at 77°F (25°C), 150 g, 5 sec.	50 – 90
Flow at 140°F (60°C), 75 degree angle, 5 hrs.	5 mm
Bond at 0°F (-18°C), 100 percent extension, ½" (12.7mm) thick specimen	Pass 5 cycles
Resilience at 77°F (25°C)	25 - 60

B. Storage, heating instructions, and cautions shall be printed on each box of sealant. The sealant must be able to be reheated to application temperature at least once after the initial heat up without degradation of sealant specifications. Sealant shall have an application life at application temperature of approximately 12 to 15 hours.

C. Prior to the use of the sealant material, the contractor shall submit to the Engineer, the appropriate material certification or laboratory test indicating that the material meets specification requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Subbase under paving shall be compacted as described in Section 312000, EARTH MOVING. Add material meeting the requirements of ordinary borrow to bring the subgrade to the required grade as necessary before placing base course.

B. The gravel base course shall be spread in layers upon the prepared subgrade conforming to the required line and grade. Gravel shall be placed in compacted layers not more than 4 inches thick compacted to not less than 95 percent of the maximum dry density of the material. Any stone greater than 3 inches in size shall be removed. Compaction shall continue until the surface is even and true to line and grade.

C. Gravel base course shall be placed on backfilled and compacted trenches to proper grade before placement of pavement.

D. The edges of existing pavement that is to remain shall be saw cut to an even, straight edge using a power-driver rotary saw; use of a jackhammer is unacceptable. This includes road, parking lot, sidewalk, and utility trench edges.

E. Asphalt courses shall be spread and compacted to the finished thicknesses as shown on the Contract Drawings. A smooth even surface shall be produced.

F. Any joints at junctions of old and new pavements shall be sealed with tack coat and covered with sand.

3.2 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.3 COLD MILLING

A. This work consists of removing bituminous or cement concrete pavements by use of a cold planer in areas designed on the Contract Drawings. The cold planer must be equipped with an elevating device capable of loading planed material directly into dump trucks while operative. It shall have all the necessary safety devices, such as reflectors, headlights, taillights, flashing lights, and backup signals so as to operate safely in traffic both day and/or night.

B. The cold planer shall be designed and built for planing flexible pavements and possess the ability to plane cement concrete patches when encountered in bituminous pavement. It shall be self-propelled and have the means for planing without tearing or gouging the underlying surface. Variable lacing patterns shall be provided to permit a rough grooved or smooth surface as directed.

C. The cold planer shall be able to make up to a 3 inch cut or any specified lesser depth may be required in one pass. The minimum width of pavement planed in each pass shall be 6

feet, except in areas to be trimmed and edged. The machine shall be adjustable as to crown and depth and meet the standards set by the Air Quality Act for noise and air pollution.

D. The planed surface shall conform to the grade and cross-slope required. The surface shall not be torn, gouged, shoved, broken, or excessively grooved. It shall be free of imperfections in workmanship that prevent resurfacing after this operation. Surface texture shall be as specified by the Engineer and excess material shall be removed so the surface is acceptable to traffic if required.

E. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

3.4 PATCHING

A. Existing Hot-Mix Asphalt Pavement: Saw-cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Existing Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a minimum rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at minimum temperature of 250 deg F.

2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: ASTM D 2041, per MHD Specifications.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 ASPHALT CURBS

A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F.

1. Asphalt Mix: Same as pavement surface-course mix.

B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.10 CURBING AND EDGING

A. Construct curbing and edging of the type and at the locations shown on the Contract Drawings.

B. Construct curbing and edging in accordance with the details shown on the Contract Drawings.

1. The foundation for curb and edging shall consist of gravel spread upon the subgrade and after being thoroughly compacted shall be 6 inches in depth. The bottom of the curbstones shall be fully seated and supported on the compacted subgrade.

2. The joints between curbstones shall be carefully filled with cement mortar and neatly pointed on all exposed surfaces.

3. After pointing, the curbstones shall be cleaned of all excess mortar.

C. After curbing and edging is in place at the line and grade shown on the Contract Drawings, backfill and compact equally on both sides with subbase course material, as specified in Section 312000 – EARTH MOVING. Compaction shall be by vibratory, hand-operated equipment, and shall achieve the same density as specified for subbase course in Section 312000 – EARTH MOVING.

3.11 INSTALLATION TOLERANCES

A. Accessibility: Comply with requirements of Massachusetts Architectural Access Board and ADAAG requirements. Remove and replace paving that does not meet required tolerances when measured with a 2 foot straight edge.

B. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

C. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within MHD Specification tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas.

3.12 SEALCOATING

A. Contractor shall provide all tools and equipment necessary to perform the work, including but not limited to brushes, hand squeegees, pumps and hose equipment, storage tanks, mixing tanks, water distributors, power sweepers, blowers, barricades, and applicator equipment.

1. Spray equipment used on the job shall have full sweep mechanical agitators incorporated in their construction to assure homogeneous mixing of the asphalt emulsion sealer, sand, and water (if required). The pumping system must be adequate to apply a uniform coating at the specified rates of application. Equipment requiring pressurization of the mixing tank for distribution will not be used.

2. Motorized squeegee application equipment used on the job will have two or more devices such as squeegees and/or drag broom assemblies to assure even distribution of the asphalt emulsion sealer. A full sweep mechanical agitator will be incorporated into the construction of the applicator to assure homogeneous mixing of the emulsion.

3. Mixing or agitating equipment may be either portable powered or a tank-type power mixer. In any case, mixers shall be of sufficient capacity to assure homogeneous mixing of the emulsion and to maintain complete suspension of mineral aggregate until the emulsion is applied to the pavement. All storage tanks shall be equipped with mechanical agitators sufficient to keep the asphalt emulsion homogeneous during storage.

B. The contractor shall coordinate their activities with each other to ensure the availability of the work area to avoid delaying the execution of the project, to maintain traffic flow, and to minimize activities that might be detrimental to the work in progress, other customer or construction traffic.

C. Surface to receive sealcoat must be free of all foreign material and dry immediately prior to application of sealer.

D. Remove oil and grease spots that have not permanently damaged or softened the pavement by scrubbing with a detergent and flushing with water until a water-break-free surface is obtained. Oil and grease spots with deeper penetration will be treated by burning with hand held propane torch, and then coating the spot with an approved oil spot primer compatible with the sealer. If the oil spot is so severe as to cause permanent deterioration of the pavement, or if the pavement has failed due to other causes, the pavement shall be removed to the full depth of the damage and replaced with new asphalt pavement.

E. Existing pavement markings shall be blackened with black epoxy or black acrylic coatings. Excessive buildup of old lines should be abraded before any prime coats of emulsion are applied.

F. Cracks in excess of 1/4", but less than one inch in width must be crack filled prior to application.

G. Pavement shall be cleaned by air blowing, vacuum, or mechanical sweeper.

H. Asphalt sealcoat shall not be placed on new asphalt concrete until a 30 day cure time has occurred.

I. Application of asphalt sealcoat shall be by mechanical means using rubber faced squeegees, brooms, distributor bar/wand in combination. Two (2) coat application.

1. The coating shall be applied uniformly over the entire pavement surface and free of voids and pinholes. Subsequent coats shall be applied only after the previous coat is dried, preferably after 24 hours of cure time, but after no less than 4 hours under ideal conditions. Ideal conditions are temperatures in excess of 70º F, sunshine, and less than 60% relative humidity. Marginal conditions can require curing times greater than 24 hours. Subsequent coats shall be applied at right angles to the previous coat, if possible.

2. First coat mechanical squeegee self−propelled is recommended, but wand application is allowed. Second coat by spray wand to lock down exposed aggregate and to return the parking lot to a proper aesthetic appearance free of streaks and marks.

3. Application rate for each coat shall be 13 to 17 gallons per 1,000 SF as recommended by the Asphalt Sealcoat Manufacturers Association. Alternative application rates may be allowed if approved by Engineer.

4. Sealer shall not be applied unless the temperature is a minimum 50º F and rising and pavement temperature is 60º F and rising. Work shall be completed so that there is a minimum of three hours of sunlight remaining after completing the day's work. Sealer shall not be applied under rainy or wet conditions such as an overcast sky with high humidity. UNDER NO CIRCUMSTANCES shall work, be performed under cold and/or wet conditions, nor shall emulsion be used that has been subjected to freezing weather.

5. In hot weather application 80º F or higher (pavement temperatures are in excess of 120º F) fog spraying of pavement with potable water shall be used to achieve better bond and even spreading of material. Properly applied fog spray shall dampen pavement without leaving puddles. Seal coat application shall not commence until it is determined there is no standing water to prevent even application and drying of the asphalt sealer.

6. Striping for parking and traffic flow should be done only after the sealcoat has dried completely to accept approved traffic paint

J. PAVEMENT CLEANING AND PROTECTION

1. The pavement surface and all work areas shall be left in a clean condition.

2. Vehicular traffic shall not be permitted on the pavement that has been sealed during the dry period. The contractor shall supply all temporary traffic control devices (barricades, cones, signing, etc.) to protect the sealant. Any damage to uncured sealant shall be repaired at the contractor's expense.

3.13 CRACK FILLING/SEALING

A. Contractor shall provide all tools and equipment necessary to perform the work, including but not limited to Routers (Vertical−Spindle and/or Rotary−Impact), Hot Compressed Air Heat Lance, Hot-applied Sealant Applicators, Wire−brushes, and compressed air equipment.

1. Router: The routing machine shall be an impact router equipped with carbide-tipped vertical-sided bits. It shall be portable and capable of routing existing asphalt surfaces along and adjacent to the crack and joint. The unit shall be capable of following random cracks and be designed to adjust the cutting widths. The unit shall be equipped with a cutter head clutch and shall have an adjustable depth control.

2. Hot Compressed-Air Lance (HCA): The HCA shall be capable of producing air temperature up to 2500^{o}F and constructed of suitable hardware. It shall be provided with separate valves to control propane, burner air, and lance air. The fuel and burner air shall be mixed only at the point of combustion before leaving the burner tube. A separate air lance tube shall pass inside the burner chamber and be orificed to a maximum 1/4". At the fuel source, a high-pressure regulator to control fuel pressure from 5 PSI to 30 PSI and to prevent flashback shall be used. Burner BTU should range from 20,000 to 500,000 BTU. A wheel kit constructed to keep the unit at the proper height and angle from the pavement should be used. No external flame shall be allowed to touch the pavement.

3. Hot-Applied Sealant Applicator (melter): The melter applicator unit shall be a self-contained double boiler device with the transmittal of heat through a heat transfer oil. It must be equipped with an onboard automatic heat-controlling device to permit the attainment of a predetermined temperature, then maintain that temperature as long as required. The unit shall have a means to vigorously and continuously agitate the sealant. The sealant shall be transferred from the unit to the crack by means of a direct-connected feed hose and wand. The equipment should be designed to allow the sealant to be circulated back into the unit when sealing is not being performed or equipped with a temperature controlled heated hose and wand that does not require circulation. The sealant should not be heated to a temperature in excess of that specified by the manufacturer.

B. CRACK PREPARATION PROCEDURES

1. Hairline cracks (less than ¼") require no preparation

2. Small to Medium Cracks (1/4" to 1-1/4"): All open cracks and joints from 1/4" to 1-1/4" shall be routed to remove at least 1/8" from each sidewall. This will result in a minimum reservoir width of 1/2" to a maximum reservoir width of 1-1/2". Widening the cracks 1/8" from each sidewall will reduce the potential for raveling of the pavement along the edges of cracks and will provide a sealant reservoir that has vertical faces. The depth of the routing shall be approximately a one to one ratio (width to depth), with a minimum depth of approximately ¾". Backer rods can be used for deeper cracks (over 1-1/4" deep) to minimize material loss and still provide an acceptable seal.

3. Large Cracks (Greater than 1-1/4"). Cracks wider than 1-1/4" shall be prepared in the same manner as potholes. A saw shall be used to cut away damaged pavement to provide a vertical face. The area should then be cleaned and filled with hot mix asphalt instead of sealed.

4. No sealant shall be installed until all cracks and joints have to be cleaned free of all deleterious materials, including any dust, old sealant, incompressible material, and

organic material, and are sufficiently dry. Following the initial routing and cleaning operation, all cracks and joints shall be HCA lanced within 10 minutes of application of the sealant. Equipment for the two operations should be kept in a compact configuration such that not more than 50 feet separates equipment required by the two operations. Extreme care shall be used to ensure the crack sidewalls do not become overheated and burned.

5. When vegetation exists in the cracks and joints, it shall be removed and those cracks and joints shall be treated with a herbicide that sterilizes the soil.

C. APPLICATION OF CRACK AND JOINT SEALANT

1. The sealant shall be applied in the crack or joint reservoir uniformly from the bottom to the top and shall be filled without formation of entrapped air or voids.

2. Pouring pots or gravity-fed sealant applicators shall not be used for sealing cracks and joints.

3. Joints and cracks shall be filled flush with the surface and any overfill shall be squeegeed so that the overband cap does not exceed 1/16” above the surface and the width does not exceed 2” beyond the crack edges.

4. All overbanding shall be kept to a minimum. After the sealant has cooled, settling shall not exceed 3/8” below the surface.

D. PAVEMENT CLEANING AND PROTECTION

1. The pavement surface and all work areas shall be left in a clean condition.

2. Vehicular traffic shall not be permitted on the pavement in the areas of the treated cracks and joints during the curing period. The contractor shall supply all temporary traffic control devices (barricades, cones, signing, etc.) to protect the sealant. Any damage to uncured sealant shall be repaired at the contractor’s expense.

3.14 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Designer.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.15 WHEEL STOPS

A. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.16 FIELD QUALITY CONTROL

A. Independent Testing Agency: Cooperate with the Independent Testing Agency engaged by Owner for field quality control activities for the Work of this Section. Refer also to Section 014325 - TESTING AGENCY SERVICES.

B. Test the plane of the finished surfaces of base, binder, and surface courses with a 16-foot straightedge, except use a 10-foot straightedge on vertical courses and on the top course of resurfaced streets which contain manhole covers, valve boxes, and the like.

C. Carefully apply the straight edge immediately after the first compaction by rolling, and from then on as may be necessary until and after the final compaction of the material in place. Hold the straightedge in successive positions parallel to the road centerline and in contact with the road surface; check the entire area from one side of the pavement to the other.

D. Correct irregularities which vary 3/8 inch from a true finished surface in base and binder courses, and 1/4 inch in top courses.

E. Irregularities which may develop before the completion of rolling and while the material is still workable may be remedied by loosening the surface mixture and removing or adding material as necessary. Should any unsatisfactory irregularities or defects remain after final compaction, the defective work shall be corrected by removing and replacing with new material to form a true and even surface.

3.17 OPENING TO TRAFFIC

A. No vehicular traffic or loads shall be permitted on the newly completed pavement until all of the following conditions are met:

1. Adequate stability has been attained.

2. The material has cooled sufficiently to prevent distortion or loss of fines.

3. The pavement has achieved a maximum temperature of 140 degrees F.

B. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Designer.

3.18 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from the Project site, and legally dispose of them in an EPA-approved landfill.

END OF SECTION

SECTION 321313.13

CONCRETE PAVING (SITE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete sidewalk and plazas.

B. Related Sections:

1. Section 033000 "CAST-IN-PLACE CONCRETE (SITE)" for general concrete footing applications.
2. Section 310000 "EARTHWORK" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
3. Section 321373 "CONCRETE PAVING JOINT SEALANTS" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
4. Section 321413.19 “INTERLOCKING CONCRETE PAVER MATERIALS” for precast concrete paving units.

1.3 REFERENCES

A. The following Standards shall apply to the Work of this Section:

1. ACI: American Concrete Institute:
Guide for Measuring, Mixing, Transporting and Placing Concrete: 304R.
Hot Weather Concreting: 305R.
Standard Specifications for Cold Weather Concreting: 306.1.
Standard Practice for Curing Concrete: 308.
Building Code Requirements for Structural Concrete and Commentary: 318.
Detailing Manual: SP-66.

2. ASTM: American Society for testing and Materials:
Specification of Concrete Aggregates: C33.
Ready-Mixed Concrete: C94.
Portland Cement: C150.
Air Entraining Admixture for Concrete: C260.
Chemical Admixtures for Concrete: C494.
Blended Hydraulic Cements (Metric): C595M.
Chemical Admixtures for Use in Producing Flowing Concrete: C1017.

Packaged Dry, Hydraulic Cement Grout (Nonshrink): C1107.
Preformed Expansion Joint Filler for Concrete (Bituminous Type): D994.
Concrete Joint Sealer, Hot-Poured Elastic Type: D1190.
Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types): D1751.
Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction: D1752.

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 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Indicate pavement Control / Contraction and Expansion joint layout plan for review and approval by Owner's Representative.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. 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 of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where required by Owner's Representative and not less than 96 inches (2400 mm) by 96 inches (2400 mm).
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Submit Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

F. Submit Qualification Data: For firms and persona specified in "Quality Assurance" article to demonstrate their capabilities and experiences. Include lists of completed projects with project names and addresses of architects and owners, and other information specified.

G. Submit 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.

H. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.

b. Quality control of concrete materials and concrete paving construction practices.
c. Pavement Joints.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Semi-rigid joint filler.
6. Joint-filler strips.
7. Repair materials.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Engage and experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performances.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

C. Source Limitations: Obtain each type of class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.9 ADA AND MAAB COMPLIANCE

A. Special attention is to be given to compliance with the American with Disabilities Act (ADA) and the requirements of the Massachusetts Architectural Access Board (MAAB).

1. Slopes: All Walkways as defined by Section 22.1 of 521 CMR shall be graded to a maximum 4.5%. The cross pitch (perpendicular to travel) for all walkways and paths shall be constructed at 1.5% (1.9% maximum). All Plazas as defined by Section 22.3.2 of 521 CMR shall be graded to a maximum 2% in any direction. The slope of sidewalks ramps and handicap curb cuts as defined by Section 21.1 of 521 CMR shall be constructed at 7.5% maximum. Ramps as defined by Section 24.1 of 521 CMR shall be constructed to a maximum slope of 7.5% and shall have code compliant handrails.
2. The Contractor is to assume that all grades in pedestrian paths of travel shall be verified/checked with a four-foot electronic "Smart Level".
3. A 5'-0" minimum level (1.5% pitch, 1.9% maximum) area shall be provided at all flush entrances to buildings. Puddling of water at the entrances will not be allowed.

B. The above requirements shall supersede the grades shown on the Drawings. If these requirements cannot be met with the grades as shown on the Drawings, the Owner's Representative shall be notified immediately.

1.10 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

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, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

C. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

2.3 CONCRETE MATERIALS

A. Cement: Shall be American-made Portland Cement; and conform to chemical and physical requirements of ASTM C150/C 150M for Type I for exposed concrete and Type II, low alkali, standard gray color for all other work.

B. A maximum of 15% fly ash or 30% slab is to be used to comply with the requirements of LEED v4 BD+C.

C. Use set retarding admixtures during hot weather only when approved by Owner's Representative.

D. Prepare design mixtures, proportioned according to ACI 211.IR-91 and ACI 304 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trail mixes or field experience.

1. Use a qualified independent testing agency for prepping and reporting proposed concrete mixture designs for the trail batch method.

E. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28-days): 4,000 psi (27.6 MPa).
2. Water/Cement Ratio (maximum): 0.45-percent by weight (mass).
3. Slump Limit: Maximum 3-inches (16.2 mm) to 5-inches (125 mm) a time of placement.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent, plus or minus 1 percent at point of delivery for ¾ inch nominal maximum aggregates size (applies to footings and foundation walls and all other concrete exposed to freeze/thaw action).

G. Limit water-soluble, chloride ion content in hardened concrete to 0.15-percent by weight of cement.

H. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

I. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements, only as authorized by the Owner in writing as follows:

1. Fly Ash or Pozzolan: 25-percent.

J. Color Pigment: No Color Pigment should be added to concrete mixture.

K. Water: ASTM C 94/C 94M and potable.

L. Concrete Transit Mixers: Mix concrete materials in transit mixers, complying with requirements of ASTM C 94.

1. At ambient temperatures of 85 to 90 degrees F, reduce mixing and delivery time to 75 minutes.
2. At ambient temperatures above 90 degrees F, reduce mixing and delivery time to 60 minutes.

2.4 CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

B. Water: Potable.

2.5 JOINT MATERIALS, GENERAL

A. Compatibility: Provide joint backings and other related materials that are compatible with one and other and with products provided under Section 321373 "CONCRETE PAVING JOINT SEALANTS".

B. Location of joints shall comply with plans. Submit layout of joints for review and approval prior to proceeding with the work.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber; 1/2-inch (12.7 mm), unless otherwise indicated.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2,400 psi (16.5 MPA) in 48-hours, and 7,000 psi (48.2 MPa) in 28-days.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

3.2 SUBBASE

A. Prepare subbase in accordance with Section 310000 “EARTHWORK (SITE)”.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Section 312000 "EARTHWORK (SITE)".

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.4 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides 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.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

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.

E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.6 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use [bonding agent] [epoxy bonding adhesive] at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Extend joint fillers full width and depth of joint.
2. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

a. Tolerance: Ensure that sawed joints are within 3 inches (75 mm)> either way from centers of dowels.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel 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 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. 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.

G. Consolidate concrete according to ACI 301 (ACI 301M) 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.

H. Screed paving surface with a straightedge and strike off.

I. 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.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) 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 design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in 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.

3.8 FLOAT 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.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. 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. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.9 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 (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by a combination of these as the following:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
6. Vertical Alignment of Dowels: 1/4 inch (6 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.

8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

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 one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Owner’s Representative, 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 Owner’s Representative 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 required by Owner’s Representative.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Owner’s Representative.

B. Drill test cores, where required by Owner’s Representative, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313.13

SECTION 321373

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.

B. Related Sections:

1. Section 321313.13 "CONCRETE PAVING (SITE)" for constructing joints in concrete pavement.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, Samples of materials that will contact or affect joint sealants.

1. Use 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.
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, not older than 24 months, of sealant products for compatibility with and adhesion to joint substrates and other materials matching those submitted.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Pavement-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

D. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.7 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.
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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Owner's Representative from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Sika Corporation; 728 NS.
b. Crafco Inc., an ERGON company; RoadSaver Silicone.
c. Dow Corning Corporation; 888.
d. Pecora Corporation; 301 NS.

2.3 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

A. Primers: Product 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.

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.

B. Joint Priming: Prime joint substrates where indicated or 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.

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. Joint-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 joint-sealant backings of kind indicated to support joint 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 joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place joint 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.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements 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 joint sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

A. Clean off excess joint 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.

3.5 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 and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within cement concrete pavement.

1. Joint Location:

   a. Expansion and isolation joints in cast-in-place concrete pavement.
   b. Contraction joints in cast-in-place concrete slabs.
   c. Other joints as indicated.

2. Silicone Joint Sealant for Concrete: Single component, self-leveling.
3. Joint-Sealant Color: As selected by Owner’s Representative from manufacturer's full range.

END OF SECTION 321373

SECTION 321413.19

INTERLOCKING PERMEABLE CONCRETE PAVER MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Permeable Interlocking Concrete Pavers
2. Permeable Joint opening aggregate
3. Permeable Setting Bed Aggregate (Open-graded)
4. Permeable Base Aggregate (Open-graded)
5. Permeable Subbase Aggregate (Open-graded)

B. Related Sections:

1. Section 033000 "CAST-IN-PLACE CONCRETE (SITE)" for cast-in-place concrete curbs that serve as edge restraints for permeable | porous paving.
2. Section 310000 "EARTHWORK" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.

Note: These related sections refer to standard specifications available from the local municipality or highway agency or from major specification writing agencies such as the Federal Highway Administration (FHWA), the National Stone Association (NSA), the American Concrete Pavement Association (ACPA), the National Asphalt Producers Association (NAPA), the National Institute of Building Sciences (NIBS), National Master Specifications (NMS), the American Society for Testing and Materials (ASTM), etc.

1.3 REFERENCES

Note: Street, industrial, port and airport pavement thicknesses shall be designed in consultation with a qualified civil engineer, in accordance with established flexible pavement design procedures, LOCKPAVE® software, and in accordance with Interlocking Concrete Pavement Institute Technical Bulletins. Sample construction detail drawings are available from Unilock®. This specification may require modifications.

A. American Society for Testing and Materials (ASTM) latest addition:

1. C 29 Bulk Density and Voids in Aggregate Materials.
2. C 33, Standard Specification for Concrete Aggregates.
3. C 67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile, Section 8, Freezing and Thawing.

4. C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
5. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
6. C 144 Standard Specifications for Aggregate for Masonry Mortar.
7. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
8. C 936, Standard Specification for Solid Concrete Interlocking Paving Units.
9. C 979, Standard Specification for Pigments for Integrally Colored Concrete.
10. D 698 Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5 lb (24.4 N) Rammer and 12 in. (305 mm) drop.
11. D 1557 Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (44.5 N) Rammer and 18 in. (457 mm) drop.
12. C1645-06 Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units
13. D 1883, Test Method for California Bearing Ratio of Laboratory-Compacted Soils.
14. D 2940 Graded Aggregate Material for Bases or Subbases for Highways or Airports.
15. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

Note: In order to determine the latest version of the listed specifications and standards, please consult the ASTM web page (www.astm.com)

B. Illinois Department of Transportation:

1. Standard Specifications for Road and Bridge Construction, January 2009, including all addenda.

C. U.S. Green Building Council Leadership in Energy and Environmental Design (LEED)

1. New Construction & Major Renovation ver. 2.2 Reference Guide, Second Edition.

1.4 SUBMITTALS

A. Permeable Interlocking Concrete Pavers:

1. Samples for verification: Three representative full-size samples of each paver type, thickness, color and finish that indicate the range of color variation and texture expected upon project completion.
2. Accepted samples become the standard of acceptance for the product produced.
3. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C 936.
4. Manufacturer’s catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.

B. Permeable Joint Opening Aggregate:

1. Provide three representative one pound samples in containers of aggregate materials that indicate the range of color variation and texture expected upon project completion.
2. Accepted samples become the standard of acceptance for the product produced.
3. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C 136.
4. Test results for void space percentage per ASTM C 29.

C. Permeable Setting Bed, Base and Subbase Aggregate:

1. Test results from an independent testing laboratory for compliance with ASTM D 448 No. 8, No. 57 and No. 2.
2. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C 136.
3. Test results for void space percentage per ASTM C 29.

D. Paving Installation Contractor:

1. Job references from a minimum of three projects similar in size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

E. LEED

1. Submit certification stating the percentage and amount by weight and value of recycled aggregate utilized.
2. Submit certification stating the location and distance from the project where recycled concrete aggregate was produced.
3. Submit certification stating the location and distance from the project where non-recycled aggregate was extracted.
4. Submit certification stating the location and distance from the project where permeable pavers were produced.

1.5 QUALITY ASSURANCE

A. Utilize a Manufacturer having at least ten years of experience manufacturing interlocking concrete pavers on projects of similar nature or project size.

B. Source Limitations:

1. Obtain Permeable Interlocking Concrete Pavers from one source location with the resources to provide products of consistent quality in appearance and physical properties.
2. Obtain Permeable Joint Opening Aggregate from one source with the resources to provide materials and products of consistent quality in appearance and physical properties.

C. Paving Contractor Qualifications:

1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
2. Utilize a Contractor conforming to all local, state/provincial licensing and bonding requirements.

D. Mockups:

1. Install a 7 ft x 7 ft paver area.
2. Use this area to determine surcharge of the bedding aggregate layer, joint sizes, lines, laying pattern(s) and levelness.
3. This area will be used as the standard by which the work will be judged.
4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
5. If mock-up is not retained, remove and properly dispose.

1.6 DELIVERY, STORAGE & HANDLING

A. In accordance with Conditions of the Contract and Division 1 Product Requirement Section.

B. Manufacturer required to complete production of materials within 30 days after order has been placed to avoid construction delays.

C. Deliver Permeable Interlocking Concrete Pavers in manufacturer's original, unopened and undamaged container packaging with identification labels intact.

1. Coordinate delivery and paving schedule to minimize interference with normal use of streets and sidewalks adjacent to paver installation.
2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.
3. Unload pavers at job site in such a manner that no damage occurs to the product or adjacent surfaces.

D. Store and protect materials such that they are kept free from mud, dirt and other foreign materials.

1.7 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Do not install permeable pavers on bedding sand.
2. Do not install pavers on frozen permeable setting bed aggregate materials.
3. Do not install pavers over frozen permeable base or subbase aggregates.
4. Do not install permeable base or subbase aggregates over frozen subgrade.

1.8 PERMEABLE INTERLOCKING CONCRETE PAVER MAINTENANCE

A. Provide a minimum of 5% additional material for overage to be used during construction.

B. Contractor to provide 100 square feet of each product and size used to owner for maintenance and repair. Furnish Pavers from the same production run as installed materials.

C. Manufacture to supply maintenance and reinstatement manuals for Permeable Interlocking Concrete Paver units.

1.9 LEED REQUIREMENTS

A. Maximize the use of recycled concrete aggregate for aggregate in the design mixes.

B. Obtain sand utilized in manufacturing the Permeable Interlocking Concrete Paver within 500 miles of the project.

C. Obtain recycled concrete aggregates utilized in manufacturing the Permeable Interlocking Concrete Paver within 500 miles of the project.

D. Obtain non-recycled concrete aggregates utilized in manufacturing the Permeable Interlocking Concrete Paver within 500 miles of the project.

PART 2 - PRODUCTS

2.1 PERMEABLE INTERLOCKING CONCRETE PAVERS

A. Basis-of-Design Product: The permeable interlocking concrete paver shapes are based on:

1. Unilock or Approved Equal:

a. Eco-Line or Approved Equal.

2. As manufactured by:

a. Unilock New York, New England Division; 35 Commerce Drive; Uxbridge, MA 01569; TEL: (508)278-6700; WEBSITE: www.unilock.com; Daniel Neviackas Massachusetts Sales Representative; TELE: 508 341 4306 or your local Territory Manager or Approved Equal.

3. The specified products establish minimum requirements that Approved Equal products must meet to be considered acceptable.

B. Product requirements:

1. Permeable Paver: Unilock Eco-Line or Approved Equal

a. Color: Summer Wheat
b. Finish: Standard
c. Chamfer: 3 mm bevel
d. Size: Manufacture the sizes indicated with a maximum tolerance of plus or minus 1/16 in all directions.

C. Provide pavers meeting the minimum material and physical properties set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units. Efflorescence shall not be a cause for rejection.

1. Average compressive strength 8000 psi (55MPa) with no individual unit under 7,200 psi (50 MPa).
2. Average absorption of 5% with no unit greater than 7% when tested according to ASTM C 140.
3. Resistance to 50 freeze-thaw cycles, when tested according to ASTM C1645-06, with no breakage greater than 1.0% loss in dry weight of any individual unit. Conduct this test method not more than 12 months prior to delivery of units.

Note: Efflorescence is a whitish powder-like deposit that sometimes appears on concrete products. Calcium hydroxide and other water-soluble materials form or are present during the hydration of Portland cement. Pore water becomes saturated with these materials, and diffuses to the surface of the concrete. When this water evaporates, the soluble materials remain as a whitish deposit on the concrete surface. The calcium hydroxide is converted to calcium carbonate during a reaction with carbon dioxide from the atmosphere. The calcium carbonate is difficult to remove with water. However, the efflorescence will wear off with time, and it is advisable to wait a few months before attempting to remove any efflorescence. Commercially available cleaners can be used, provided directions are carefully followed. Some cleaners contain acids that may alter the color of the pavers.

D. Accept only pigments in concrete pavers conforming to ASTM C 979. ACI Report No. 212.3R provides guidance on the use of pigments.

E. Maximum allowable breakage of product is 5%.

F. TX Active is a Portland Cement (white) Type I, II, and III complying with ASTM C 150 with the addition of proprietary particles of titanium dioxide (TiO2) specifically engineered for use in the manufacture of concrete and concrete products.

1. TX Active - Self-cleaning and pollution reduction

   a. Concrete will resist most organic and inorganic pollutants that gather on the surface causing discoloration.
   b. Concrete will remove significant amounts of environmental pollutants deemed harmful to human health.

2. As manufactured by ESSROC Italcementi Group.

   a. Unilock is an authorized producer of TX Active products.

2.2 PERMEABLE JOINT OPENING AGGREGATE

A. Provide Permeable Joint Opening Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 8 as shown in Table 1

TABLE 1 - ECO-LINE
PERMEABLE JOINT OPENING AGGREGATE
GRADATION REQUIREMENTS

ASTM No. 8	
Sieve Size	**Percent Passing**
1/2 in (12.5 mm)	100
3/8 in (9.5 mm)	85 to 100
No. 4 (4.75 mm)	10 to 30
No. 8 (2.36 mm)	0 to 10
No. 16 (1.18 mm)	0 to 5

2.3 PERMEABLE SETTING BED AGGREGATE

A. Provide Permeable Setting Bed Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 8 as presented in Table 3

TABLE 3
PERMEABLE SETTING BED AGGREGATE
GRADATION REQUIREMENTS

ASTM No. 8	
Sieve Size	**Percent Passing**
½ in (12.5 mm)	100
3/8 in (9.5 mm)	85 to 100

No. 4 (4.75 mm)	10 to 30
No. 8 (2.36 mm)	0 to 10
No. 16 (1.18 mm)	0 to 5

2.4 PERMEABLE BASE AGGREGATE

A. Provide Permeable Base Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 57 as presented in Table 4

TABLE 4
BASE AGGREGATE
GRADATION REQUIREMENTS

ASTM No. 57	
Sieve Size	**Percent Passing**
1-1/2 in (37.5 mm)	100
1 in (25 mm)	95 to 100
1/2 in (12.5 mm)	25 to 60
No. 4 (4.75 mm)	0 to 10
No. 8 (2.36 mm)	0 to 5

2.5 PERMEABLE SUBBASE AGGREGATE

A. Provide Permeable Subbase Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 2 as presented in Table 5

TABLE 5
SUBBASE AGGREGATE
GRADATION REQUIREMENTS

ASTM No. 2	
Sieve Size	**Percent Passing**
3 in (75 mm)	100
2-1/2 in (63 mm)	90 to 100
2 in (50 mm)	35 to 70
1-1/2 in (37.5 mm)	0 to 15
3/4 (19 mm)	0 to 5

Note: Provide washed, clean, have zero plasticity, free from deleterious or foreign matter, crushed, angular rock and contain no No. 200 sieve size aggregate materials used in the construction of permeable pavement. Aggregate materials serve as the structural load bearing platform of the pavement as well as a temporary receptor for the infiltrated water that is collected through the openings in the pavement's surface.

2.6 GEOTEXTILE (Optional depending on soil conditions)

A. Properties:
1. A nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Provide Geotextile inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.
2. Grab Tensile Strength: ASTM D 4632: MD 160 lbs., CD 160 lbs.
3. Apparent Opening Size (AOS): ASTM D 4751: 0.212 mm, 70 U.S. Sieve
4. Permittivity: ASTM D 4491: 1.4 sec -1
5. Flow Rate: ASTM D 4491: 110 gal/min/s.f.

2.7 EDGE RESTRAINTS

A. Edge Restraint as indicated.

Note: The provision of suitable edge restraints is critical to the satisfactory performance of interlocking concrete block pavement. Abut pavers tightly against the restraints to prevent rotation under load and any consequent spreading of joints. Install sufficiently stable edge restraints that are, in addition to providing suitable edge support for the paver units, able to withstand the impact of temperature changes, vehicular traffic and/or snow removal equipment.

Curbs, gutters or curbed gutter, constructed to the dimensions of municipal standards (noting that these standards generally refer to cast-in-place concrete sections), are considered to be acceptable edge restraints for heavy duty installations. Where extremely heavy industrial equipment is involved such as container handling equipment, the flexural strength of the edge restraint shall be carefully reviewed, particularly if a section that is flush with the surface is used and may be subjected to high point loading.

Provide Edge restraints along all unrestrained paver edges and supported on a minimum of 6 in. (150mm) of aggregate base.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving for compliance with requirements for installation tolerances and other conditions affecting performance before placing the Permeable Interlocking Concrete Pavers.

1. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
2. Verify that Geotextiles, if applicable, have been placed according to drawings and specifications.
3. Verify that Permeable Base and Subbase Aggregate materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
4. Provide written density test results for soil subgrade, Permeable Base and Subbase Aggregate materials to the Owner, General Contractor and paver installation subcontractor.
5. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Verify that the soil subgrade is free from standing water.

B. Stockpile Permeable Setting Bed, Joint, Base and Subbase Aggregate materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

C. Remove any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities before placing the Geotextile and Permeable Subbase Aggregate materials.

D. Keep area where pavement is to be constructed free from sediment during entire job. Remove and replace all Geotextile, Permeable Joint, Setting Bed, Base and Subbase Aggregate materials contaminated with sediment with clean materials.

E. Complete all subdrainage of underground services within the pavement area in conjunction with subgrade preparation and before the commencement of Permeable Subbase Aggregate construction.

F. Do not damage underdrain pipes, overflow pipes, observation wells, or inlets and other drainage appurtenances during installation. Report all damage immediately.

G. Compact soil subgrade uniformly to at least 90 percent of Standard Proctor Density per ASTM D 698 for pedestrian areas. Compact soil subgrade uniformly to at least 95 percent Modified Proctor per ASTM D 1557 for vehicular areas.

H. Proof-roll prepared subgrade according to requirements in Division 31 Section "Earth Moving" to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting and replace with compacted backfill or fill as directed.

Note: Compaction of the soil subgrade shall be based on the recommendations of the Designing Engineer. The Owner's Representative/Engineer shall inspect subgrade preparations, elevations and conduct density tests for conformance to specifications.

Note: Mechanical tampers (jumping jacks) are recommended for compaction of soil subgrade and aggregate base around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions. Areas not accessible to roller compaction equipment shall be compacted to the specified density with mechanical tampers. **CAUTION** - Care shall be taken around the perimeters of excavations, buildings, curbs, etc. These areas are especially prone to consolidation and settlement. Wedges of backfill shall not be placed in these areas. If possible, backfilling and compacting in these areas particularly shall proceed in shallow lifts, parallel to the finished surface.

3.3 INSTALLATION

A. EDGE RESTRAINTS

1. Provide edge restraints as indicated.

a. Install job-built concrete edge restraints to comply with requirements in Division 3 Section "Cast-in-Place Concrete."
b. Provide concrete edge restraint along the perimeter of all paving as specified. Install the face of the concrete edge restraint, where it abuts pavers vertical down to the subbase.
c. Construct concrete edge restraint to dimensions and level specified and support on a compacted subbase not less than 6 in (150 mm) thick.

B. GEOTEXTILES

1. Provide separation geotextile on bottom and sides of prepared soil subgrade. Secure in place to prevent wrinkling or folding from equipment tires and tracks.
2. Overlap ends and edges a minimum of 18 in. (450 mm) in the direction of drainage.

C. PERMEABLE BASE AND SUBBASE AGGREGATE

1. Provide the Permeable Subbase Aggregate in uniform lifts not exceeding 6 in., (150 mm) loose thickness and compact to at least 95 percent as per ASTM D 4254 to depths as indicated.
2. Compact the Permeable Subbase Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the roller.
3. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Subbase Aggregate material more than ±3/4 in. (20 mm) over a 10 ft. (3 m) long straightedge laid in any direction.
4. Provide the Permeable Base Aggregate material in uniform lifts not exceeding 6 in. (150 mm) over the compacted Permeable Subbase Aggregate material and compact to at least 95 percent as per ASTM D 4254 to depths as indicated.
5. Compact the Permeable Base Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the roller.
6. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Base Aggregate material more than ±1/2 in. (13 mm) over a 10 ft. (3 m) long straightedge laid in any direction.
7. Grade and compact the upper surface of the Permeable Base Aggregate material sufficiently to prevent infiltration of the Permeable Setting Bed Aggregate material both during construction and throughout its service life.

   Note: In-place density of the Permeable Base and Subbase Aggregate materials may be checked per ASTM D 4254. Compacted density shall be 95% of the laboratory index density established for the subbase and base stone.

D. PERMEABLE SETTING BED AGGREGATE

1. Provide and spread Permeable Setting Bed aggregate evenly over the base course and screed to a nominal thickness of 1-1/2 in. (40 mm).

   a. Do not disturb screeded Permeable Setting Bed Aggregate.
   b. Do not substantially exceed screed area which cannot be covered by pavers in one day.
   c. Do not use Permeable Setting Bed Aggregate material to fill depressions in the base surface.
2. Keep moisture content constant and density loose and constant until pavers are set and compacted.

3. Inspect the Permeable Setting Bed Aggregate course prior to commencing the placement of the permeable interlocking concrete pavers.

E. PERMEABLE INTERLOCKING CONCRETE PAVERS

1. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.
2. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
3. Exercise care in handling face mix pavers to prevent surfaces from contacting backs or edges of other units.
4. Provide Permeable Interlocking Concrete Pavers using joint pattern as indicated. Adjust joint pattern at pavement edges such that cutting of edge pavers is minimized. Cut all pavers exposed to vehicular tires no smaller than one-third of a whole paver.
5. Place units hand tight against spacer bars. Adjust horizontal placement of laid pavers to align straight.

    a. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
6. Provide space between paver units of 1/32 in. (1 mm) wide to achieve straight bond lines.
7. Do not exceed joint (bond) lines more than ±1/2 in. (±15 mm) over 50 ft. (15 m) from string lines.
8. Fill gaps between units or at edges of the paved area that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.
9. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
10. Do not allow traffic on installed pavers until Permeable Joint Aggregate has been vibrated into joints. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and Permeable Joint Aggregate material. .
11. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a to 5000-lbf (22-kN) compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

    a. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
    b. Compact installed concrete pavers to within 6 feet (1,800 mm) of the laying face before ending each day's work. Cover pavers that have not been compacted and leveling course on which pavers have not been placed, with nonstaining plastic sheets to prevent Permeable Setting Bed Aggregate from becoming disturbed.
12. Remove any cracked or damaged pavers and replace with new units prior to installing Permeable Joint Opening Aggregate material.
13. Provide, spread and sweep Permeable Joint Opening Aggregate into joints immediately after vibrating pavers into Permeable Setting Bed course until full. Vibrate pavers and add Permeable Joint Aggregate material until joints are completely filled, then remove excess material. This will require at least 4 passes with a plate compactor.
14. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage). Do not exceed 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.
15. Remove excess Permeable Joint Aggregate broom clean from surface when installation is complete.

3.4 FIELD QUALITY CONTROL

A. Verify final elevations for conformance to the drawings after sweeping the surface clean.

1. Do not deviate final surface tolerance from grade elevations more than ±□3/8 in. (±10 mm) under a 10 ft (3 m) straightedge or indicated slope, for finished surface of paving.

B. Set surface elevation of pavers 1/8 in. (3 mm) above adjacent drainage inlets, concrete collars or channels.

C. Lippage: No greater than 1/8 in. (3 mm) difference in height between Permeable Interlocking Concrete Pavers and adjacent paved surfaces.

3.5 REPAIRING, CLEANING AND SEALING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Cleaning: Remove excess dirt, debris, stains, grit, etc. from exposed paver surfaces; wash and scrub clean.

1. Clean Permeable Concrete Pavers in accordance with the manufacturer’s written recommendations.

C. Seal as indicated.

1. Apply Sealer for Permeable Concrete Pavers in accordance with the manufacturer’s written recommendations.

3.6 PROTECTION

A. Protect completed work from damage due to subsequent construction activity on the site.

3.7 PERMEABLE JOINT AGGREGATE MATERIAL REFILLING

A. Provide additional Permeable Joint Aggregate material after 120 days and before 150 days after date of Substantial Completion/Provisional Acceptance.

1. Fill Permeable Joint Aggregate material full to the lip of the paver.

3.8 LIFE CYCLE ACTIVITIES

A. Paver cleaning: Clean Permeable Interlocking Concrete Pavers as needed to remove staining, dirt, debris, etc.

1. Clean per manufacturers recommendations.

B. Maintenance: Permeable Joint Aggregate Material.

1. Annually inspect Permeable Joint Aggregate material for areas clogged with debris.
2. Vacuum or sweep as necessary to restore surface infiltration.
3. Remove debris by vacuuming or sweeping Permeable Joint Aggregate

    a. Replenish removed Permeable Joint Aggregate material with clean aggregate material flush to paver lip.
    b. Sweep excess material from paver surface.

END OF SECTION 321412.19

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Chain Link fences.
2. Gates: swing.

B. Related Sections:

1. Section 033000 "CAST-IN-PLACE CONCRETE (SITE)" for cast-in-place post footings.
2. Section 031200 "EARTHWORK (SITE)" for excavation for installing concrete footings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions.

C. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Accessories: Privacy slats.
4. Gates and hardware.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Factory-authorized service representative.

B. Product Certificates: For each type of chain-link fence and gate, from manufacturer.

C. Product Test Reports: For framing strength according to ASTM F 1043.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:

1. Polymer finishes.
2. Gate hardware.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding. Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of gate operators and controls.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire Fabric: Wire with a diameter of 0.120 inch (3.05 mm).

a. Mesh Size: 2 inches (50 mm).
b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 2, 2.0 oz./sq. ft. (610 g/sq. m) with zinc coating applied before weaving.
c. Polymer-Coated Fabric: ASTM F 668, Class 2b over Zinc-coated steel wire.

1) Color: As selected by Owner’s Representative from manufacturer's full range, complying with ASTM F 934.

d. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

3. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:

1. Fence Height: As indicated on Drawings.
2. Light Industrial Strength: Material Group II-L, roll-formed steel C-section shapes.

a. Line Post 2.25 by 1.7 inches (57 by 43 mm).
b. End, Corner and Pull Post: 2.25 by 1.7 inches (57 by 43 mm).

3. Horizontal Framework Members: top and bottom rails complying with ASTM F 1043.

a. Top Rail: 1.25 by 1.63 inches (32 by 41 mm).

4. Brace Rails: Comply with ASTM F 1043.
5. Metallic Coating for Steel Framing:

a. Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.

6. Powder coating over metallic coating.

   a. Color: As selected by Owner's Representative from manufacturer's full range, complying with ASTM F 934.

2.3 SWING GATES

A. General: Comply with ASTM F 900 for gate posts and single and double swing gate types.

1. Gate Leaf Width: As indicated.
2. Gate Fabric Height: As indicated.

B. Pipe and Tubing:

1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framing.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded or assembled with corner fittings.

D. Hardware:

1. Hinges: **180-degree outward** swing.
2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Lock: Manufacturer's standard internal device furnished in lieu of gate latch.
4. Closer: Manufacturer's standard.

2.4 FITTINGS

A. General: Comply with ASTM F 626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.
2. Rail Clamps: Line and corner boulevard clamps for connecting bottom rails in the fence line-to-line posts.

E. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

F. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel: 0.148-inch- (3.76-mm-) diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

2. Band-it Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel or Stainless Steel: self-locking head with smooth edge, Nominal Size: 15", Actual Length: 14.9 inch / 378 mm; Width: 0.187 inch / 4.76 mm; Max Bundle Diameter: 4"; Minimum Loop Tensile: 200 lb. Coating thickness and finish to match coating of chain-link fence fabric.

G. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.

a. Polymer coating over metallic coating.

2.5 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

2.6 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Copper.
2. Material on or below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches (16 by 2440 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Owner's Representative.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

1. Install fencing on established boundary lines inside property line.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.
b. Concealed Concrete: Top 2 inches (50 mm) below grade as indicated on Drawings to allow covering with surface material.
c. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
d. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material

manufacturer's written instructions, and finished sloped to drain water away from post.

3. Mechanically Driven Posts: Drive into soil to depth of 36 inches (914 mm). Protect post top to prevent distortion.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more.

D. Line Posts: Space line posts uniformly at 10 feet (3 mm) o.c.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches (1830 mm) or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

G. Intermediate and Bottom Rails: Install and secure to posts with fittings.

H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.

J. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

K. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. Direction and privacy factor as indicated.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1500 feet (450 mm) except as follows:

1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).

a. Gates and Other Fence Openings: Ground fence on each side of opening.

1) Bond metal gates to gate posts.
2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.

C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:

1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.

D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

E. Connections: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

F. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.7 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance no fewer than two full days after last trace of precipitation, without soil having been moistened by any means other than

natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Owner's Representative promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 323300

SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section consists of providing all labor, equipment, materials, incidental work and construction methods necessary to furnish and install designated Site Improvements and related items as indicated on the Drawings, as specified in this Section, and includes, but is not limited to, the following:

1. Bicycle rack.
2. Safety bollard with vehicular chain.
3. Flush granite edge.

B. Related Sections: The following items of related Work are specified and included in other Sections of the Specifications:

1. Section 033000 "SITE CAST-IN-PLACE CONCRETE (SITE)" for installing pipe sleeves cast in concrete footings.
2. Section 321216 “ASPHALT PAVING” for setting of granite edging.
3. Section 312000 "EARTHWORK" for excavation for installing concrete footings and backfill of granite edging.

1.3 REFERENCES

A. The following Standards shall apply to the work of this Section:

1. Commonwealth of Massachusetts Highway Department (MHD) Specifications: Standard Specifications for Highways and Bridges.

2. ASTM: American Society for Testing and Materials:
Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service: A193/A193M-99a.
Stainless Steel Bars and Shapes: A276-98b.
Seamless and Welded Austenitic Stainless Steel Pipes: A312.
Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes: ASTM A 500.
Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing: ASTM A 513.
Standard Practice for Operating Salt Spray (Fog) Apparatus: ASTM B 117.
Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings: ASTM D 522.

Standard Test Method for Specular Gloss: ASTM D 523.
Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity: ASTM D 2247.
Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact): ASTM D 2794.
Standard Test Methods for Measuring Adhesion by Tape Test: ASTM D 3359.
Standard Test Method for Film Hardness by Pencil Test: ASTM D 3363.
Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials: ASTM G 155.

3. AISI: American Iron and Steel Institute:
   Stainless Steel Alloy Designation: AISI 304.
   Stainless Steel Alloy Designation: AISI 316.

4. AWS: American Welding Society:
   Structural Welding Code – Stainless Steel: D1.6-99.

5. ISO Testing Standards:
   Paints and Varnishes – Cupping Test: ISO 1520.
   Paints and Varnishes – Buchholz Indentation Test: ISO 2815.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Prior to ordering the below listed materials, submit Shop Drawings to the Owner's Representative for approval as follows:

1. Provide shop drawings for the concrete footings of each site item specified herein.
2. Provide shop drawings for Bicycle Rack installation and plan locations.
3. Provide shop drawings for Safety Bollard with vehicular chain typical installation.
4. Provide Shop Drawings for flush granite edge showing details of stone pieces indicating: cross sections, elevations showing layout of all pieces, sizes, dimensions, finishes, arrangement and provisions for joining, anchoring, cut-outs and holes, and other necessary details for reception of other Work.

B. Manufacturer's Literature: Submit copies of each of the manufacturer's material descriptions and installation instructions for the following. Do not order materials until Owner Representative's approval has been obtained. Delivered materials shall closely match the approved samples:

1. Bicycle rack.
2. Safety bollard with vehicular chain.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Verification: For each type of exposed finish, not less than 6-inch long linear components and 4-inch square sheet components.

1. Include full-size Samples of bicycle rack.

E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful site furnishing installations.

1. Experience: Three years' experience in site furnishing installation of similar quality, schedule requirement and construction detailing.
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time foreman or crew leader on Project site when work is in progress.

1.7 GUARANTEE

A. All site improvements' parts shall be guaranteed against workmanship and material defects for one-year from time of delivery, or as noted herein.

PART 2 - PRODUCTS

2.1 BICYCLE RACKS

A. Products: Subject to compliance with requirements, provide the following:

1. Bicycle Rack shall be Model# Dero Hoop; Finish: TGIC Polyester Powder Coating, color silver, embedded, as manufactured by Dero Bike Rack Co., 504 Malcolm Avenue SE, Suite 100, Minneapolis, MN 55414, TEL: 888-337-6729, FAX: 612-331-2731 or Approved Equal.

2.2 SAFETY BOLLARD WITH VEHICULAR CHAIR

A. Products: Subject to compliance with requirements, provide the following:

1. Bollard Pipe Material shall be six-inch diameter; standard schedule 40 steel pipe; embedded; filled and anchor encased with 300 psi concrete cement; paint color black.

2.3 FLUSH GRANITE EDGE

A. Products: Subject to compliance with requirements, provide the following:

1. Granite: Landscape Grade – Uniform color variation of light and dark grey and white tones with black flecking in shapes and sizes indicated, bevel edge units that transition from the face of the playground surface (By Others) to the adjacent surface below it with a straight-sloped outside edge. Provide border edge and corner units where surface does not abut vertical surfaces.

2. Size: 5 or 6 inch wide by 6 to 8 feet long pieces. Contractor shall use the longest pieces possible with few smaller pieces (preferably greater than 3 feet). Contractor shall submit a curb schedule and layout for Owner's Representative review and approval, showing the play equipment use zones and dimensions of each curb piece.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211.
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 221.
3. Structural Pipe and Tube: ASTM B 429/B 429M.
4. Sheet and Plate: ASTM B 209.
5. Castings: ASTM B 26/B 26M.

B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
6. Perforated Metal: From steel sheet not less than **0.075-inch** nominal thickness; manufacturer's standard perforation pattern.
7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
8. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
9. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.

C. Anchors, Fasteners, Fittings, and Hardware: commercial quality, tamperproof, vandal and theft resistant

1. Angle Anchors: For inconspicuously bolting legs of site furnishings to grade substrate.
2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate.

D. Concrete Footing: Concrete footing shall be 4,000 pounds per square inch (30MPa), 28 day strength air entrained, 3/4 inch aggregate cast-in-place concrete as specified in Section 033010 “CAST-IN-PLACE CONCRETE (SITE)”. Concrete footings shall be placed as shown on the Drawings.

E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.

F. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

G. Self-leveling Polyurethane Sealant: Provide 2 or more part, self-leveling, polyurethane based elastomeric sealant, complying with ASTM C 920, Type 1 Class A, having Shore A hardness of

not less than 30 when tested according to ASTM C 920, cured modulus of elasticity at 50 percent elongation of not more than 150 psi, when tested according to ASTM D 412, and tear resistance of not less than 50 pounds per inch when tested according to ASTM D 624. Where joint surfaces contain bituminous materials, provide modified sealants which are compatible with bituminous materials encountered.

H. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:

1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 ounces/square foot of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
2. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.5 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.6 GENERAL FINISH REQUIREMENTS

A. 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.

2.7 ALUMINUM FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and positioned at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than outside diameter of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

G. Flush Granite Edge: Install edge restraints before placing playground surfacing (By Others). All edge restraints shall be flush to avoid any tripping hazards or dips that could cause differential settlement of surfacing, ponding of water and ultimately failure of safety surfacing (By Others).

1. Embed flush granite edge in concrete and allow concrete to cure before placing crushed stone base and remainder of surfacing.

3.3 GENERAL ACCEPTANCE STANDARDS

A. Site Furnishings items specified within this Section 323300, “SITE FURNISHINGS”, will be rejected by the Owner’s Representative for the following reasons and as determined by the Owner’s Representative:

1. Upon installation, horizontal or vertical curves do not meet the shapes and profiles shown on the Drawings. Curves that have broken backs, sags, saddles, tangents or kinks will be rejected.
2. Posts are not plumb. Rails do not follow grade as noted on the Drawings.
3. Indications of field welding or cutting.
4. Threaded connections are not drawn up tightly. Threads have not been deformed to prevent loosening.
5. Anchorage into concrete or masonry is not solid but is perceptibly loose. Anchorage does not meet the requirements in the Drawings.
6. Finishes that do not meet the Specifications or Drawings, due to damage that occurred onsite, manufacturing error or other causes.
7. Flush granite edge is not installed to minimize sharp edges, protrusions, and tripping hazards.

3.4 MISCELLANEOUS METALS ACCEPTANCE STANDARDS

A. Miscellaneous metal items, including handrails, bollards and specialty fencing will be rejected by the Owner’s Representative for the following reasons:

1. Welders were not qualified under or did not perform work in accordance with AWS “Standard Qualification Procedure.”
2. Fabricated items show metal pieces that were not accurately saw cut and were not fitted together. Gaps, spaces, voids, breaks and crooks in arriss lines, humps, bumps, sags and saddles are present.
3. Sections are not well formed and do not meet the shapes and profiles shown in the Drawings.
4. Horizontal or vertical curves do not meet the shapes and profiles shown in the Drawings. Curves that have broken backs, sags, saddles, tangents or kinks shall be rejected.
5. Connections are not full seam welded or not ground flush and smooth.
6. Threaded connections are not drawn up tightly. Threads have not been deformed to prevent loosening.
7. Exposed surfaces do not have a smooth finish and show surface differentiation and variation. Edges show nicks, grind marks or machine marks.
8. Castings do not have sharp corners and edges and are not clean, smooth and true to pattern.
9. Welds are not continuous extending for the entire length of the joints.
10. Welds are not ground smooth.
11. The presence of flux deposits.
12. Welds are not water tight.

END OF SECTION 323300

SECTION 329200

TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes providing all labor, equipment, materials, incidental work and construction methods required to perform all turf and grass installation and fine grading work and related items as indicated on the Contract Documents and/or as specified herein, and includes, but is not limited to, the following:

1. Fine grading and loaming.
2. Seeding.
3. Hydroseeding.
4. Turf renovation for damaged areas.
5. Maintenance and protection.

B. Related Sections: The following items of related Work are specified and included in other Sections of the Specifications:

1. Section 329300 "PLANTS" for border edgings.

1.3 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

1.5 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

B. Qualification Data: Submit proof of qualified landscape Installer to the Owner’s Representative in accordance with QUALITY ASSURANCE paragraph of this Section.

C. Product Certificates: At least 30 days prior to ordering materials, the Contractor shall submit to the Owner’s Representative samples, certifications, manufacture’s product data and certified test results for materials as specified below. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Owner’s Representative. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner’s Representative reserves the right to reject, on or after delivery, any materials which does not meet these Specifications:

1. Fertilizer: Submit product literature of seeding fertilizer and certificates showing composition and analysis.
2. Erosion Control Matting: Submit one copy of manufacturer’s literature and one material sample.
3. Soil Additives: Submit product literature on all soil additives to be used on site.
4. Limestone: Submit supplier’s certificate that the limestone being supplied conforms to these Specifications.
5. Hydroseeding: Submit a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water.
6. Wood Cellulose Fiber Mulch: Submit one copy of manufacturer’s literature and one material sample.

D. Material Test Reports: For sampling and testing of Loam Borrow from Off-Site Sources and from On-Site Sources shall be as specified in QUALITY ASSURANCE paragraph of this Section.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in turf installation of similar quality, schedule requirement and construction detailing.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time foreman or crew leader on Project site when work is in progress.
4. Personnel Certifications: Installer's foreman or crew leader shall be either a certified landscape professional or a certified horticulturalist:

    a. Landscape professional shall be a Massachusetts Certified Landscape Professional currently certified by the Associated Landscape Contractors of Massachusetts.
    b. Horticulturalist shall be a Massachusetts Certified Horticulturalist as currently certified by the Massachusetts Nursery and Landscape Association.
    c. Certified Turfgrass Professional, designated CTP.

5. Pesticide Applicator: State of Massachusetts licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; buffer pH, Soluble Salts, and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Owner's Representative. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for turf growth.

    a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 square feet or volume per cubic yard for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Pre-Construction Walk: Conduct pre-construction site walk at the Project site at a day and time specified by the Owner's Representative.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed, Fertilizer and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable at time of first use. Any packaged materials that become caked or otherwise damaged will not be acceptable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, limestone and soil amendments with appropriate certificates.

1.8 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Seed Spring Planting: April 1 to May 30.
2. Seed Fall Planting: August 15 to October 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions. When special conditions warrant a variance to the turf operations, proposed times shall be submitted to the Owner's Representative for approval prior to implementation.

1.9 WARRANTY

A. Warranty: Provide written warranty agreeing to remove and replace work that exhibits defects in materials or workmanship for the specified periods. "Defects" is defined to include, but is not limited to; death, unsatisfactory growth, disease, abnormal foliage density, abnormal size, abnormal color, failure to thrive and other unsatisfactory characteristics.

B. Replacement: Replace each defective plant or work with same species, size, character, and quality of originally accepted work. With each replacement plant or material, provide a new one-year warranty for the replacement work. If a replacement is unacceptable during its one year warranty, the Contractor shall provide another replacement or, when approved by Owner, equivalent cash payment.

C. Replacement Planting Season: Planting and reseeding for replacement and warranty work shall comply with the planting season contained herein.

D. Owner's Responsibilities and Warranty Exclusions: After completion of the Contractor's maintenance responsibilities, the Owner is responsible for maintaining the work in reasonable compliance with the Contractor's maintenance instructions. The Contractor's warranty shall exclude problems due to improper or inadequate maintenance after the maintenance period or vandalism.

E. Contractor Responsibilities: During the warranty period the Contractor shall visit the site at 1 month intervals to review the conditions of the accepted work. The Contractor shall submit in writing his/her concerns regarding the Owner's maintenance practices and/or any vandalism. The Owner shall make reasonable efforts to correct the problems cited by the Contractor but the Owner shall not be held responsible for the Contractor's defects in materials or workmanship that result in decline or death to plants and lawns.

F. Failure of the Contractor to make the required monthly review of the site during the warranty period and submit written notice to the Owner of maintenance defects shall negate the Contractor's ability to make claim against the Owner for negligence of maintenance.

G. Warranty Period for Lawns: One Year from date of final acceptance.

1.10 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Seeded Turf: 60 days from date of final acceptance of lawn areas.

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances. Grass seed shall be of the previous year's crop and in no case shall weed seed content exceed 1 percent by weight. The seed shall be furnished and delivered in the proportion specified below in new, clean and properly labeled containers. All seed shall comply with State and Federal seed laws. Submit manufacturer's Certificate of Compliance. Seed that becomes wet, moldy or otherwise shall not be acceptable. Chewings fescue, hard fescue, tall fescue and ryegrass shall contain *Acromonium* endophytes. Seed containing endophyte must be kept cool and dry at all times; do not stockpile in the sun.

B. Grass Seed Mixes:

1. General Seed for Temporary Cover are as follows:

a. Annual Ryegrass; 40 pounds per acre (1 pound per 1000 square feet); Recommended seeding date – April 1st to June 1st.
b. Foxtail Millet; 30 pounds per acre (0.7 pounds per 1000 square feet); Recommended seeding dates – May 1st to June 30th.

c. Oats; 80 pounds per acre (2 pounds per 1000 square feet); Recommended seeding dates – April 1st to July 1st and August 15th to September 15th.
d. Winter Rye; 120 pounds per acre (3 pounds per 1000 square feet); Recommended seeding dates – August 15th to October 15th.
e. Seeding rate for winter application shall be 3 tons per acre (150 pounds per 1000 square feet). Mulch shall not be spread on top of snow. Snow must be removed down to one inch depth or less prior to application.
f. Mulching rate shall be 1.5 to 2 tons per acre (2 bales (70-90 pounds) per 1000 square feet). Hay or straw mulch shall be air-dried, free of undesirable seeds and coarse materials. There should be no bare spots showing.

2. General Lawn Seed Mixture Composition; shall be "PUREGANIX ELITE Mix" composed by the following species as supplied by: Pure Solutions, 582 Boston Post Road, Weston, MA 02493, TEL: 781.899.7873; Shawn Spear Massachusetts Sales Representative; Proportioned by weight as follows or per Approved Equal:

a. 39.78% Barvado Tall Fescue.
b. 34.95% Barrobusto Tall Fescue.
c. 14.81% RPR Perennial Ryegrass.
d. 3.74% Barrari (Sod) Kentucky Bluegrass.
e. 2.98% Barvette (Sod) Kentucky Bluegrass.
f. 2.98% Barimpala (Sod) Kentucky Bluegrass.
g. Seeding rate for the Sustainable Lawn Seed Mix shall be 436-pounds per acre (10 pounds / 1000 square feet) as recommended by the supplier.
h. Seed may be mixed by an approved method on the site or may be mixed by a dealer. If the seed is mixed on site, each variety shall be delivered in the original containers that bear the dealer's guaranteed analysis. If the seed is mixed by a dealer then the Contractor shall furnish to the Owner's Representative the dealer's guaranteed statement of the composition of the mixture.
i. THIS PRODUCT IS ALWAYS IN STOCK. The general lawn mix will need to be ordered in 2,000-pound increments only, and with a 3 to 4-week lead time.

3. Shade Lawn Seed Mixture Composition; shall be "PUREGANIX SHADY Lawn Mix" composed by the following species as supplied by: Pure Solutions, 582 Boston Post Road, Weston, MA 02493, TEL: 781.899.7873; Shawn Spear Massachusetts Sales Representative; Proportioned by weight as follows or per Approved Equal:

a. 50% Gladiator Hard Fescue/ Hardtop Hard Fescue.
b. 30% Bridgeport II Chewing Fescue.
c. 15% Contender Strong Creeping Red Fescue.
d. 5% RPR Perennial Ryegrass.
e. Seeding rate for the Shade Lawn Seed Mix shall be 225 pounds per acre (5 pounds/ 1000 square feet) as recommended by the supplier.
f. Seed may be mixed by an approved method on the site or may be mixed by a dealer. If the seed is mixed on site, each variety shall be delivered in the original containers that bear the dealer's guaranteed analysis. If the seed is mixed by a dealer then the Contractor shall furnish to the Owner's Representative the dealer's guaranteed statement of the composition of the mixture.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 6.5 to 8.0; moisture content 35 to 55 percent by weight; 100 percent passing through 3/8 inch or smaller sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 40 percent of dry weight.
2. Nutrient Content: The material shall contain some nitrogen, phosphorous, potassium, calcium, magnesium, sodium and micro nutrients including iron, copper, boron, manganese and molybdenum so that heavy application of fertilizers is not required to sustain plant growth. Also, the nutrients shall be present in appropriate agricultural and horticultural proportions to prevent ion antagonism.
3. Heavy Metals: Concentrations of zinc, mercury, cadmium, lead, nickel, chromium, and copper must be below EPA and State of Massachusetts standards for applications to soils with human activity.
4. Pesticide Residue: Composted organic materials shall not contain any pesticide residues of any kind.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 23 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium. Fertilizer shall be a commercial product complying with the State and United States fertilizer laws. Deliver to the site in the original unopened containers that bear the manufacturer’s certificate of compliance covering analysis. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil analysis, but shall be adjusted as recommended.

1. Composition: 1 pound / 1000 square feet of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium. Fertilizer shall be a commercial product complying with the State and United States fertilizer laws. Deliver to the site in the original unopened containers that bear the manufacturer’s certificate of compliance covering analysis. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil analysis.

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.5 PLANTING SOILS

A. Planting Soil for Seeded Lawn: ASTM D 5268 topsoil, screened, sandy loam that is fertile, friable natural loam free from subsoil, clay, brush, litter, roots, stones 3/4 inch or larger and any other foreign materials harmful to plant growth. Loam shall have an acidity range of pH 5.8 to 7.0, and shall contain not less than 4 percent or more than 6 percent organic material content as determined by the loss of ignition of oven-dried samples.

1. Mix ASTM D 5268 topsoil with the following soil amendments in the following quantities to produce planting soil:

    a. Ratio of soil mixture compositions shall be (1) part topsoil as specified above, (1) part organic matter, and (1) part native soil mixed prior to planting installation.
    b. Weight of Lime per 1000 square feet: 200 pounds maximum limit.
    c. Weight of Bonemeal per 1000 square feet: as per soil analysis.
    d. Weight of Superphosphate per 1000 square feet: 20 pounds or as required by soil analysis.
    e. Weight of Commercial Fertilizer per 1000 square feet: as per soil analysis.
    f. Weight of Slow-Release Fertilizer per 1000 square feet: as per soil analysis.

2.6 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt marsh hay or threshed straw of winter wheat, rye, oats, or barley.

B. Fiber Mulch for hydro-seeding: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5. Size Range: 1/4 inch minimum to 3/4 inch maximum. Color: Uniform tan-beige range or green range to allow for easy visual metering during application but shall be non-injurious to plant growth.

C. Nonasphaltic Tackifier for hydro-seeding: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

D. Asphalt Emulsion for straw mulching: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

E. Water: Suitable for irrigation and free of substance harmful to plant growth. Hoses, pumps, sprinklers or other methods of transportation shall be furnished by Contractor.

2.7 PESTICIDES AND HERBICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as required by Owner’s Representative and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until required to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply soil amendments and/or fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading.
3. Spread planting soil in two equal lifts to a depth of 6 inches for new lawn and 2 inches for overseed, but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.

a. Apply soil amendments and/or fertilizer directly to surface soil before loosening.

3. Remove stones larger than 2 inches in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Remediation of Compacted or Poorly Drained Subsoil in Planted Areas: If the soils are deemed to be compacted or poorly draining, the Contractor shall remedy the condition prior to proceeding with further work. Remove any vegetative growth on the surface of the work area. Remove any extraneous materials. Loosen subgrade with a backhoe bucket to a depth of 18 inches. After gathering subsoil in the bucket, drop soil onto the ground from a height of 6 feet to break up the soil clumps. Position backhoe during work to prevent re-compaction of soils beginning the work in corners or against walls, or the center of isolated beds, and progressing outward towards the border’s edge. After subgrade has been broken up, rototill entire area to a depth of 6 inches. Heavy clay soils shall be amended with organic material.

E. Finish Grading: Set sufficient grade stakes for checking finished grades. Stakes must be set at the top and bottom of slopes. Grades shall be established which are accurate to $1/10^{th}$ of a foot either way. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/4 inch of finish elevation. Limit finish grading to areas that can be planted in the immediate future.

F. Scarifying: After loam has been spread, 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 1 inch in diameter shall be removed from the loam. Loam shall also be free of smaller stones in excessive quantities as determined by the Owner’s Representative.

G. Rolling: Roll the entire surface with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, remove all ridges and all depressions caused by settlements or rolling shall be filled with additional loam and the surface shall be regarded and rolled until it presents a smooth and even finish to the required grade or to the shapes and configurations shown on the details.

H. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

I. Before planting, obtain Owner’s Representative's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
3. Apply fertilizer to the topsoil at a rate of 25 pounds / 1000 square feet. Work the soil into the top 4 inches of the topsoil.

B. Spread the seed mixture in **two passes at 90 degrees to each other**.

C. Sow seed at a total rate of 3 pounds / 1000 square feet on each pass for a total application of 6 pounds / 1000 square feet.

D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

E. Protect seeded areas with slopes exceeding 3:1 with erosion control blankets or erosion control fiber mesh, installed and stapled / anchored according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 6:1 by spreading straw mulch. It is the Contractor’s responsibility to place the mulch at its optimum thickness and to add or remove mulch as necessary to encourage seed germination, plant growth and to prevent erosion. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Or if required by Owner’s Representative, bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gallons / 1000 square feet. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Water with a fine spray. Watering shall be started 7 days after completing the seeded area. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 1 inch. Run-off and puddling shall be prevented.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with non-asphaltic tackifier as recommended by the manufacturer.
2. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500 pounds / acre dry weight, and seed component is deposited at the rate of 6 pounds / 1000 square feet for lawn areas. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 pounds / acre. Apply fertilizer at the rate of 3 pounds /1000 square feet.
3. Remove all overspray and repair all surfaces that are rutted or otherwise damaged by the hydroseeding materials or vehicle to a condition satisfactory to the Owner’s Representative.
4. Take all necessary precautions to prevent overspray on structures, pavements and plantings adjacent to the seed areas.

3.6 TURF RENOVATION FOR DAMAGED AREAS

A. Renovate existing turf.

B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

J. Apply seed or sod as required by Owner’s Representative as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.7 PROTECTION

A. Erect warning signs and barricades (consisting of stakes with plastic tape) as required by the Owner’s Representative to protect newly seeded areas from pedestrian, bicycle and vehicular traffic. Maintain barricades throughout the maintenance period until turf is accepted by the Owner’s Representative. If requested by the Owner’s Representative, Contractor shall remove the barricades prior to acceptance of the newly planted areas.

3.8 TURF MAINTENANCE

A. The maintenance period for turf and grasses shall begin immediately after the seeding has occurred and shall continue until final acceptance by the Owner’s Representative.

B. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, edging, replanting dead areas, disease and insect control, erosion repair, and performing other operations as required and consistent with good horticultural practices to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

C. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

D. Mowing and Edging:

1. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Mow turf areas a minimum of three times before acceptance by the Owner's Representative.
2. At each mowing, all edges of walks, drives, plant beds and other border conditions shall be edge trimmed by hand or machine to produce a straight and uniform edge condition.
3. Remove and discard from paved areas only clippings and debris generated by each mowing and edging operation legally off-site. Owner's Representative, if practical and aesthetic, may allow sweeping (not blowing) clippings back into grass. Mowers shall be equipped with mulching blades. Do not remove from grass areas any clippings that have been generated by mowing operations.
4. Schedule initial and subsequent mowing to maintain the following grass height:

    a. Mow General Lawn Seed Mixture to a height of 2 inches.
    b. Mow Shade Lawn Seed Mixture to a height of 2 inches.

5. All mowing will be scheduled on a weekly basis, depending on the month and weather, as designated by the Owner's Representative.

E. Turf Post-fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. The first application of fertilizer as specified herein occurs during the initial installation of turf seed.
2. A second application of fertilizer as specified herein shall be applied to seeded areas at the time of the first mowing. This second application shall be applied at a rate that ensures a nitrogen application of at least 1/2 pound / 1000 square feet. Phosphorous and potassium shall be applied proportionally in accordance with the recommendations of the soil tests and the quantities previously integrated into the soil during the first application.
3. A third application of nitrogen fertilizer shall be applied to seeded areas approximately two months after the second. This third application shall correspond to the following application rates dependent upon the month of application.

    a. May 1 through May 15: Use fertilizer that will provide actual nitrogen of at least 1 pound / 1000 square feet to turf area.

b. June 15 through June 30: Use fertilizer that will provide actual nitrogen of at least 1 pound / 1000 square feet to turf area.
c. August 15 through September 15: Use fertilizer that will provide actual nitrogen of at least 1 pound / 1000 square feet to turf area.
d. November 1 through November 15: Use fertilizer that will provide actual nitrogen of at least 1 1/2 pounds / 1000 square feet to turf area.

F. Applying limestone

1. The Contractor shall return to the site at the beginning of the next seeding season and spread limestone across all lawn areas installed under this Contract. Limestone shall be spread at rates determined by the soil tests specified.

3.9 SATISFACTORY TURF

A. Request for Acceptance: In writing, request Owner's Representative inspection for acceptance at least 10 days in advance of preferred acceptance date. Do not request inspection for acceptance until work is 100 percent complete (not including maintenance) and in compliance with Contract requirements.

B. Partial Acceptance: Acceptance of partial areas or portions of the total work may be granted, at the Owner's option, if the area to be inspected is large, well-defined, and easily described. The Owner and Owner's Representative are not obliged to provide partial acceptance of the work.

C. Turf installations shall meet the following criteria as determined by Owner's Representative:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds, undesirable grass species, disease, insects and surface irregularities. For the purpose of establishing an acceptable standard for seeded areas, scattered bare spots not larger than 1 square foot will be permitted up to a maximum of 3 percent of any lawn area. At least 90 percent of the grass established shall be permanent grass species.

D. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 329300

PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes providing all labor, equipment, materials, incidental work and construction methods required to perform all planting installation and related items as indicated on the Contract Documents and/or as specified herein, and includes, but is not limited to, the following:

1. Planting trees, shrubs, groundcover, and perennials.
2. Planting soils.
3. Tree stabilization.
4. Landscape edgings.
5. Existing tree pruning.
6. Maintenance.

B. Related Sections: The following items of related Work are specified and included in other Sections of the Specifications:

1. Section 015639 "TEMPORARY TREE AND PLANT PROTECTION" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 311300 “SELECTIVE TREE REMOVAL AND TRIMMING” for pruning of existing trees and inspections by Certified Arborists.
3. Section 329200 "TURF AND GRASSES" for turf (lawn) planting and hydroseeding materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

H. Finish Grade: Elevation of finished surface of planting soil.

I. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

J. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

K. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

L. Planting Area: Areas to be planted.

M. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, ground covers, ornamental grasses, or herbaceous vegetation.

O. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

Q. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

R. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

S. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
3. Plant Photographs: Include color photographs in a digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Trees and Shrubs: Plant material certificates of inspection as required by government authorities. Vendor/ grower certification of plants, identifying the zone of origin that the plants were grown in.
2. Organic Mulch: 1 quart volume of each organic mulch required, in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. Antidessiccant: Submit manufacturer’s product data.
4. Mycorrhizal Fungal Inoculant: Submit manufacture’s product data certifying that inoculant being supplied conforms to these Specifications. Submit the purchasing receipt showing the total quantity purchased for the Project prior to installation. Submit empty packets of fungal spore inoculant to the Owner’s Representative for verification of use.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Submit proof of qualified landscape Installer to the Owner’s Representative in accordance with QUALITY ASSURANCE paragraph of this Section. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: At least 30 days prior to ordering materials, the Contractor shall submit to the Owner’s Representative samples, certifications, manufacturer’s product data and certified test results for materials as specified below. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Owner’s Representative. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner’s Representative reserves the right to reject, on or after delivery, any materials that do not meet these Specifications:

1. Fertilizer: Submit product literature of seeding fertilizer and certificates showing composition and analysis.
2. Soil Additives: Submit product literature on all soil additives to be used on site.
3. Manufacturer's certified analysis of standard products.
4. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Material Test Reports: For sampling and testing of Loam Borrow from Off-Site Sources and from On-Site Sources shall be as specified in QUALITY ASSURANCE paragraph of this Section.

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in landscape installation of similar quality, schedule requirement and construction detailing.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time foreman or crew leader on Project site when work is in progress.
4. Personnel Certifications: Installer's foreman or crew leader shall be either a certified landscape professional or a certified horticulturalist:

    a. Landscape professional shall be a Massachusetts Certified Landscape Professional currently certified by the Associated Landscape Contractors of Massachusetts.
    b. Horticulturalist shall be a Massachusetts Certified Horticulturalist as currently certified by the Massachusetts Nursery and Landscape Association.
    c. Certified Ornamental Landscape Professional, designated COLP.

5. Pesticide Applicator: State of Massachusetts licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; buffer pH, soluble salts, and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Owner's Representative. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.

    a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 square feet or volume per cubic yard for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such

problem materials are present, provide additional recommendations for corrective action.

D. Plants: Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1 “American Standard for Nursery Stock”. A plant shall be dimensioned as it stands in its natural position. Provide legibly tagged, healthy, vigorous stock, grown in a recognized nursery in accordance with good horticultural practices and free of disease, insect, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions or disfigurement.

1. Plant names indicated with “Standardized Plant Names” as adopted by the latest edition of the American Joint Committee on Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged. Plants not legibly tagged will be rejected.
2. Do not make substitutions. If specified landscape materials are not obtainable, submit proof of non-availability to the Owner’s Representative, together with a proposal for use of an equivalent material. Substitutions or changes on the plant species will not be permitted without prior written approval by the Owner’s Representative.
3. Selection of plants purchased under allowances will be made by the Owner’s Representative, who will tag plants at their place of growth before they are prepared for planting.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

F. Plant Material Observation: Plant material shall be inspected as required by State and Federal Laws. Notify the Owner’s Representative to perform an inspection of plant materials prior to commencing planting operations. Owner’s Representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Owner’s Representative retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Owner’s Representative of sources of planting materials 7 days in advance of delivery to site.

G. Allow Owner’s representative option of travelling to Grower’s facility to select plant materials from available stock.

H. Allow four weeks, after receipt of list of growers, to finish tagging plant materials.

I. Trees dug prior to tagging by Owner’s Representative are subject to rejection.

J. Owner’s Representative will confirm the plant materials satisfy the requirements of ANSI Z60.1 and all special conditions stated in Project Specifications and Drawings.

K. Unacceptable plant materials will not be tagged and a different Grower will be selected by Contractor at no expense to the Owner. A second tagging trip will then be scheduled.

L. Decision by Owner's Representative to forgo tagging trip does not release Contractor from responsibility of obtaining plant materials which meet the standards and conditions stated on the Project Specifications and Drawings.

M. Pre-Construction Walk: Conduct pre-construction site walk at the Project site at a day and time specified by the Owner's Representative.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Fertilizer and Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable at time of first use. Any packaged materials that become caked or otherwise damaged will not be acceptable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, and soil amendments with appropriate certificates.

C. Bare Root Stock: Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

D. Plants: Provide freshly dug plants. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Spray plants with antidessicant and provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Digging and moving of plant materials: Plants required to balled and burlapped (B&B) shall be dug and moved with compact balls of soil encompassing the root system, firmly wrapped with burlap and laced with nursery twine or wire basket. Each root ball should be of sufficient width and depth to encompass the fibrous and feeding roots necessary to insure the full recovery and development of the plant. Plants having a cracked or broken ball of soil will not be acceptable. All plants, from the time they are dug until they are planted, shall be kept shaded and otherwise protected. After digging, transport the plants immediately to the packing sheds or other cover. Adequately water both the foliage and the ball. Handle planting stock by root ball.

F. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Summer dug materials will not be accepted. Spring (dormant) dug materials that are shipped "in-leaf" shall be sprayed with antidessicant. Dig, pack, transport and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice order, and upon arrival the certificate shall be filed with the Owner's Representative. Water as often as necessary to maintain root systems to a moist condition. Handling procedures not conforming to these specifications shall result in rejection of plant material and contractor shall remove plants from site and provide replacements.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist. The planting program shall be arranged that an excessive number of unplanted plants as determined by the Owner's Representative are not stored on the site.

1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
2. Set balled stock and container grown plants on ground and cover ball with soil, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.
5. All plants that are being stored shall be kept adequately watered at all times.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Owner's Representative no fewer than 2 days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without Owner's Representative written permission.

C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1 through June 30.
2. Fall Planting: August 15 through November 15.

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements. Plant frost tender trees and shrubs only after the danger of frost is past or sufficiently before frost season to allow for establishment before the first frost. Do not plant in frozen ground.

E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

F. Existing Tree Pruning:

1. Prior to the pruning of any existing trees on the Project site, the Site Contractor shall retain the services of a Massachusetts Certified Arborist (MCA) to identify the tree species and

evaluate the health, vigor and public safety aspects of the trees identified by the Owner's Representative to receive pruning. Upon the completion of the site visit, the Massachusetts Certified Arborist shall submit an Arborist Report detailing the pruning and management aspects that are required for the identified trees.

2. Only upon approval of the Arborist Report by the Owner's Representative, the pruning of existing tree materials shall be done with Owner's permission and in the presence of the Owner's Representative.

1.9 WARRANTY

A. Warranty: Provide written warranty agreeing to remove and replace work that exhibits defects in materials or workmanship for the specified periods. "Defects" is defined to include, but is not limited to; death, unsatisfactory growth, disease, abnormal foliage density, abnormal size, abnormal color, failure to thrive and other unsatisfactory characteristics.

B. Replacement: Replace each defective plant or work with same species, size, character, and quality of originally accepted work. With each replacement plant or material, provide a new one-year warranty for the replacement work. If a replacement is unacceptable during its one year warranty, the Contractor shall provide another replacement or, when approved by Owner, equivalent cash payment.

C. Replacement Planting Season: Planting and reseeding for replacement and warranty work shall comply with the planting season contained herein.

D. Owner's Responsibilities and Warranty Exclusions: After completion of the Contractor's maintenance responsibilities, the Owner is responsible for maintaining the work in reasonable compliance with the Contractor's maintenance instructions. The Contractor's warranty shall exclude problems due to improper or inadequate maintenance after the maintenance period or vandalism.

E. Contractor Responsibilities: During the warranty period the Contractor shall visit the site at 1 month intervals to review the conditions of the accepted work. The Contractor shall submit in writing his/her concerns regarding the Owner's maintenance practices and/or any vandalism. The Owner shall make reasonable efforts to correct the problems cited by the Contractor but the Owner shall not be held responsible for the Contractor's defects in materials or workmanship that result in decline or death to plants and lawns.

F. Warranty shall not include damage or loss of trees and shrubs caused by fires, floods, freezing rains, lightning storms, winds over 75 miles per hour, winter kill caused by extreme cold, severe winter conditions not typical of planting area, and acts of vandalism, or negligence on the part of the owner.

G. Failure of the Contractor to make the required monthly review of the site during the warranty period and submit written notice to the Owner of maintenance defects shall negate the Contractor's ability to make claim against the Owner for negligence of maintenance.

H. Warranty Period for Trees and Shrubs: One Year from date of final acceptance.

I. Warranty Period for Perennials and Ground Covers: One Year from date of final acceptance.

1. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.10 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 60 days from date of final acceptance of trees and shrubs.

B. Initial Maintenance Service for Perennials, Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 60 days from date of final acceptance of perennials, ground covers and other plants.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. Plants: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1 “Standardized Plant Names” by the American Joint Committee on Horticultural Nomenclature. Botanical names take precedence over common names. Plant materials shall be nursery grown, true to the names indicated on the Contract Documents and in accordance with the names adopted by the American Joint Committee on Horticultural Nomenclature. No substitutions shall be permitted, without written approval by the Owner’s Representative. Plant Materials shall be:

1. Hardy under climactic conditions similar to those in the locality of the Project. Only plant stock grown within Hardiness Zones 1 through 6b, as established by the USDA Plant Hardiness Zone Map, latest edition, will be accepted.
2. Plant materials shall be typical of the species or variety with normal, densely developed branches and vigorous, fibrous root systems densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
3. All plants shall have fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage.
4. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
5. If at any time during the performance of the Contract, any plant shows signs of graft incompatibility, as determined by Owner’s Representative, then the tree and shrub and all

similarity grafted plants of the same Genus/Species/Variety shall be rejected and removed from the site. Visual symptoms of graft incompatibility as cause for rejection include; development of over-growths by rootstock or scion resulting in the development of shoulders or inverted shoulders, suckering of the rootstock combined with poor growth or dieback of scion, any mechanical weakness between scion and rootstock, and marked difference in bark pattern and structure between scion and rootstock.

6. Pruning wounds and damage from handling with a diameter of more than 1 inch will not be acceptable. Smaller wounds must show a vigorous growth of bark on all edges.
7. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated or approved by the Owner's Representative.

B. Quality: Provide tree and shrub size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".

C. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Owner's Representative. If the use of larger plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.

D. Plant Measurements: Plants shall meet the requirements for spread and height indicated in the Plant Schedule. The measurement for height shall be taken from the crown of the roots to the average height of the top branches of the plant, and not the tallest leader. Poorly stemmed or thin plants will not be accepted. Side branches shall be generous, well twigged and evergreen plants shall be well bushed to the ground. Plants shall be in a moist, vigorous condition, free from deadwood, bruises, or other root or branch injuries. Take caliper measurements for deciduous trees 6 inches above the ground level up to and including 4 inches caliper size, and 12 inches above the ground for larger sizes.

E. Deciduous Trees: Provide trees of height and caliper as indicated in the Plant Schedule, single stemmed with straight trunk, well-branched crown and intact single leader, with branching height 1/3 to 1/2 of tree height and with branching configuration recommended by ANSI Z60.1 for type of species required. Multiple leaders shall conform to all standards noted above and in this Section. Shade trees shall have no branching lower than 6.5 feet from finished grade. Flowering trees for use in areas away from pedestrian traffic shall have the first branch of their crowns be no higher than 4 feet from finished grade. All deciduous trees shall be balled and burlapped (B&B)

F. Evergreen Trees: Provide trees of height as indicated in the Plant Schedule, measured from the trunk flair at the natural ground line of the tree to the midpoint of the terminal leader, single stemmed with no double leaders or twin heads permitted, well-branched to the ground and with branching configuration recommended by ANSI Z60.1 for type of species required. Terminal and top whorl buds of evergreen trees shall be in healthy and whole condition at time of harvest. No evergreen tree shall be pruned after the Owner's Representative or Contractor has tagged the tree in the nursery. All trees shall have healthy, vigorous needles of normal size, color, shape, texture for the particular species and variety. All evergreen trees shall be balled and burlapped (B&B)

G. Shrubs: Provide plants of the height or spread as indicated in the Plant Schedule, and with not less than the minimum number of canes required by ANSI Z60.1 for type and height of shrub required. Container grown stock shall be grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole. Not plants shall be loose in the container. Container stock shall not be pot bound. Canes, trunk(s) and branches shall be well formed, branching uniformly distributed close to ground. Scars shall be free of rot and not exceed 1/4 the diameter of the wood beneath in greatest dimension unless completely healed, except pruning scars. Shrubs shall show no signs of frost or winter damage to the foliage. Foliage

shall not be in a state of drought stress. Leaves or needles shall show no signs of wilt or desiccation due to weather stress at any season of the year. All shrubs shall be container grown (Cont.).

H. Ground Cover: Provide plants of the size, pot size, age and condition as indicated in the Plant Schedule, and with not less than the minimum number of canes, runners, eyes, or fans required by ANSI Z60.1 for the type and size of ground cover required.

I. Perennials: Provide plants of the size, pot size, age and condition as indicated in the Plant Schedule, and with not less than the minimum number of runners, eyes, or fans required by ANSI Z60.1 for the type and size of perennials required.

J. Root-Ball: All ball and burlapped plants to have firm, natural balls of earth, of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Cracked or mushroomed balls are not acceptable. Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible and all girdling roots removed before planting. All container grown plants shall have an extensive, symmetrically balanced fibrous root system without curling or spiraling of the roots along the walls of rigid containers. All parts of the fibrous root system for balled and burlapped and container grown plants shall be moist and fresh with a white color when washed of soil. The root systems of all plants shall be free of disease, insect pests, eggs or larvae.

K. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

L. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

M. Perennials, Ground Covers and Other Plants: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. All parts of the fibrous root system for balled and burlapped and container grown plants shall be moist and fresh with a white color when washed of soil. The root systems of all plants shall be free of disease, insect pests, eggs or larvae. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 6.5 to 8.0; moisture content 35 to 55 percent by weight; 100 percent passing through3/8 inch or smaller sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 40 percent of dry weight.
2. Nutrient Content: The material shall contain some nitrogen, phosphorous, potassium, calcium, magnesium, sodium and micro nutrients including iron, copper, boron, manganese and molybdenum so that heavy application of fertilizers is not required to sustain plant growth. Also, the nutrients shall be present in appropriate agricultural and horticultural proportions to prevent ion antagonism.
3. Heavy Metals: Concentrations of zinc, mercury, cadmium, lead, nickel, chromium, and copper must be below EPA and State of Massachusetts standards for applications to soils with human activity.
4. Pesticide Residue: Composted organic materials shall not contain any pesticide residues of any kind.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and23 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium. Fertilizer shall be a commercial product complying with the State and United States fertilizer laws. Deliver to the site in the original unopened containers that bear the manufacturer’s certificate of compliance covering analysis. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil analysis, but shall be adjusted as recommended.

1. Composition: 1 pound/1000 square feet of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium. Fertilizer shall be a commercial product complying with the State and United States fertilizer laws. Deliver to the site in the original unopened containers that bear the manufacturer’s certificate of compliance covering analysis. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil analysis.

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.5 PLANTING SOILS

A. Planting Soil for Trees, Shrubs, Ground Covers and Perennials: ASTM D 5268 topsoil, screened, sandy loam that is fertile, friable natural loam free from subsoil, clay, brush, litter, roots, stones 3/4 inch or larger and any other foreign materials harmful to plant growth. Loam shall have an acidity range of pH 5.8 to 7.0, and shall contain not less than 4 percent or more than 6 percent organic material content as determined by the loss of ignition of oven-dried samples.

1. Mix ASTM D 5268 topsoil with the following soil amendments in the following quantities to produce planting soil:

a. Ratio of soil mixture compositions shall be (1) part topsoil as specified above, (1) part organic matter, and (1) part native soil mixed prior to planting installation.
b. Weight of Lime per 1000 square feet: 200 pounds maximum limit.
c. Weight of Bonemeal per 1000 square feet: as per soil analysis.
d. Weight of Superphosphate per 1000 square feet: 20 pounds or as required by soil analysis.
e. Weight of Commercial Fertilizer per 1000 square feet: as per soil analysis.
f. Weight of Slow-Release Fertilizer per 1000 square feet: as per soil analysis.

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded and aged pine bark mulch, aged a minimum of 6 months. The mulch shall be dark brown in color, between 1/2 inch and 2 1/2 inches in any direction, free from chunks and pieces thicker than 1/4 inch. Mulch must be free of stringy material, viable, noxious weed seeds and insect life, and shall not contain, in the judgment of the Owner's Representative, an excess of fine particles.
2. Size Range: 2 1/2 inch maximum, 1/2 inch minimum.
3. Color: Natural, Dark Brown.

2.7 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 TREE STABILIZATION MATERIALS

A. Stakes and Web Guys (ArborTie®) or Approved Equal:

1. Upright and Web Guy Stakes: Rough-sawn, sound, new cedar posts [**c**, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by 8'-0" length, pointed at one

end; 3 stakes per tree. The top 4-inches of all stakes shall be taped with WHITE duct tape or painted for identification purposes.

2. Web Guys and Ties: Shall be ArborTie or approved equal, a flat woven polypropylene material; 3/4-inch wide. ArborTie is a product of Deep Root Partners, L.P.; 1-800-458-7668 or fax 1-800-277-7668.
3. Guying material shall be secured by loosely connecting the ArborTie or equivalent around the central leader of tree.
4. Staking systems that are not taped or are improperly anchored will be considered incomplete and will not be paid for.
5. Plant locations in park areas to incorporate tree protection guards at the base of the tree. Guards are to be ARBORGARD+ tree trunk protectors or approved equal. ARBORGARD+ is a product of Deep Root Partners, L.P.; (800) 458-7668 or fax (800) 277-7668 or Approved Equal.

2.9 MISCELLANEOUS PRODUCTS

A. Mycorrhizal Fungi:

1. Dry, granular inoculant containing at least 5300 spores per pound of vesicular-arbuscular mycorrhizal fungi and 95 million spores per pound of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

B. Slow Release Watering Bag (Treegator Bag®) or Approved Equal:

1. 20-gallon bag to be constructed out of UV-treated polyethylene and reinforced with nylon webbing. Sides are to be made watertight with durable ¼" thick heat seals.
2. Bag is to be secured to the tree with heavy-duty nylon zippers, sewn on to each side.
3. Two water release holes at the bottom of each corner, designed to achieve 5 to 9-hour release rate.
4. Plant locations throughout site to incorporate Treegator Bags or approved equal. Treegator Bag is a product of Treegator Slow Release Watering Bag; (866) 873-3428 or fax (919) 556-9852 or Approved Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that the finished grades in the planting areas have been established before starting the planting operation.
3. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
4. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
5. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner's Representative and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Owner's Representative's acceptance of layout before excavating or planting. Make minor adjustments as required.

1. The locations shall be as shown on the Drawings unless otherwise indicated. However, due to underground obstructions or for other reasons, it may be necessary to modify the plant locations, subject to review by the Owner's Representative before the relocation.
2. The Owner's Representative reserves the right to interchange the plants or to shift the plant locations if it is possible in his/her judgment to procure a better effect by the changes.

D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 18 inches. Remove stones larger than 1 1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply soil amendments and /or fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading.
3. Spread planting soil in two equal lifts to a depth of 12 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

B. Remediation of Compacted or Poorly Drained Subsoil in Planted Areas: If the soils are deemed to be compacted or poorly draining, the Contractor shall remedy the condition prior to proceeding with further work. Remove any vegetative growth on the surface of the work area. Remove any extraneous materials. Loosen subgrade with a backhoe bucket to a depth of 18 inches. After gathering subsoil in the bucket, drop soil onto the ground from a height of 6 feet to break up the

soil clumps. Position backhoe during work to prevent re-compaction of soils beginning the work in corners or against walls, or the center of isolated beds, and progressing outward towards the border's edge. After subgrade has been broken up, rototill entire area to a depth of 6 inches. Heavy clay soils shall be amended with organic material.

C. Finish Grading: Set sufficient grade stakes for checking finished grades. Stakes must be set at the top and bottom of slopes. Grades shall be established which are accurate to 1/10th of a foot either way. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/4 inch of finish elevation. Limit finish grading to areas that can be planted in the immediate future

D. Before planting, obtain Owner's Representative's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

E. Application of Mycorrhizal Fungi: At time directed by Owner's Representative, broadcast dry product uniformly over prepared soil at application rate indicated by product manufacturer.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected overnight or after working hours.
8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Subsoil and topsoil removed from excavations may be used as planting soil upon approval by Owner's Representative.

C. Obstructions: Notify Owner's Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Owner's Representative if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow percolating before positioning trees and shrubs.

3.5 TREE AND SHRUB PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare set at such a level that after settlement, they will remain at their natural grade elevation in proper relationship to the finished grade.

1. Use planting soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Add 10-10-10 fertilizer to the surface of the soil ring under the mulch at a rate of 1 pound per caliper inch of trees and 1 pound per square yard of plant bed unless otherwise directed.
5. Continue backfilling process. Water again after placing and tamping final layer of soil. Thoroughly water all plants within 24 hours after they have been planted.
6. Create shallow watering basins around all trees and shrubs as detailed to retain and conserve moisture. Maintain the basins until the plants have established themselves or until instructed by the Owner’s Representative to remove them.

D. Set container grown stock plumb and in center of planting pit or trench with root flare at such a level that after settlement, they will remain at their natural grade elevation in proper relationship to the finished grade.

1. Use planting soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Add 10-10-10 fertilizer to the surface of the soil ring under the mulch at a rate of 1 pound per caliper inch of trees and 1 pound per square yard of plant bed unless otherwise directed.
5. Continue backfilling process. Water again after placing and tamping final layer of soil. Thoroughly water all plants within 24 hours after they have been planted.
6. Create shallow watering basins around all trees and shrubs as detailed to retain and conserve moisture. Maintain the basins until the plants have established themselves or until instructed by the Owner’s Representative to remove them.

E. Set and support bare-root stock in center of planting pit or trench with root flare at such a level that after settlement, they will remain at their natural grade elevation in proper relationship to the finished grade.

1. Use planting soil for backfill.
2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb

before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.

3. Add 10-10-10 fertilizer to the surface of the soil ring under the mulch at a rate of 1 pound per caliper inch of trees and 1 pound per square yard of plant bed unless otherwise directed.
4. Continue backfilling process. Water again after placing and tamping final layer of soil. Thoroughly water all plants within 24 hours after they have been planted.
5. Create shallow watering basins around all trees and shrubs as detailed to retain and conserve moisture. Maintain the basins until the plants have established themselves or until instructed by the Owner's Representative to remove them.

F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

C. Use the same tree spade to excavate the planting hole as was used to extract and transport the tree.

D. Plant trees as shown on Drawings, following procedures in "Tree and Shrub Planting" Article.

E. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE AND SHRUB PRUNING

A. Remove only dead, dying, split or broken branches. Do not prune for shape.

B. Do not prune the terminal leaders of the trees. On multiple leader plants, preserve the leader best promoting the symmetry of the plant. Prune branches at a point beyond a lateral bud, or a distance of not less than 1/2 the diameter of the supporting branch.

C. At the discretion of the Owner's Representative, remove 1/3 of the length of all candles on evergreen plants.

D. Prune, thin, and shape trees and shrubs according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Owner's Representative, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character. Do not remove more than 10 percent of the foliage on any individual specimen and only after approval by the Owner's Representative.

E. All cuts shall be cleanly made with sharp tools as close to the parent trunk or limb as possible. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

A. Trees in lawn areas, in grass strips and in pits with grates shall not be staked and guyed. See Contract Documents for trees to be staked and guyed.

B. Install trunk stabilization immediately after trees have been planted as follows unless otherwise indicated. When high winds or other conditions may effect tree survival or appearance occur, perform immediate staking.

C. Staking and Web Guying (ArborTie®) or Approved Equal:

1. Drive the stakes and posts 120 degrees apart from each other to a minimum depth of 3 feet below grade in undisturbed earth and to a minimum of 4 feet below grade in areas of fill. Stakes to extend at least 5 feet above grade. Set stakes to avoid penetrating root balls or masses
2. Use three stakes per tree. Space stakes equally around trees and maintain a maximum stake height of six-feet and minimum stake height of five-feet.
3. Support trees with ArborTie and allow enough slack to avoid rigid restraint of tree.
4. ARBORGARD+ tree protection guards shall be installed to manufacturer specification to ensure proper health and protection of young trees planted in lawn.

3.9 MISCELLANEOUS PRODUCTS

A. Slow-Release Watering Bag.

1. Watering Bag shall be installed to manufacturer specifications.
2. Each bag shall be filled according to manufacturer specifications at least one-time per week.
3. Bags are to be kept in working condition and are to be replaced if missing or damaged for the extent of the establishment and guarantee periods.

3.10 EXISTING TREE PRUNING

A. Pruning shall be done with Owner’s permission and in the presence of the Owner’s Representative in accordance with the Massachusetts Certified Arborist (MCA) Report and workmanship requirements of “Pruning Standards” to preserve the natural character of the trees.

3.11 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, and shrubs as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Install and fill slow-release watering bag.

H. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Tree-like Shrubs in Turf Areas:

a. Apply organic mulch ring of 2 inch average thickness, with canopy drip-line radius around trunks or stems. Do not place mulch within 2 inches of trunks or stems.
b. Thoroughly water mulched area. Rake to provide a uniform finished surface. Treat plant areas with weed retardant in accordance with manufacturer's instructions after all panting and mulching is complete.

2. Organic Mulch in Planting Areas:

a. Apply 2 inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 2 inches of trunks or stems.
b. Thoroughly water mulched area. Rake to provide a uniform finished surface. Treat plant areas with weed retardant in accordance with manufacturer's instructions after all panting and mulching is complete.

3.13 EDGING INSTALLATION

A. Shovel-Cut Edging: Separate mulched areas from turf areas with a 45-degree, 4 inch deep, shovel-cut edge as shown in Drawings.

3.14 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Restore planting saucer and adjacent material, and remove dead material.

C. Replace mulch materials damaged or lost in areas of subsidence.

D. Tighten and repair wires and stakes as required.

E. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.

F. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to

minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

G. Water trees, plants and seasonal planting beds within the first 24 hours of initial planting, and not less than twice per week until final acceptance. Monitor and fill slow-release watering bags. Coordinate watering by irrigation system with Owner's Representative.

H. Maintenance shall also include follow-up, at the end of the warranty period.

1. Remove and renew wood mulch saucer.
2. Remove stakes from trees.
3. Remove slow-release watering bags from trees.
4. Fertilize trees and shrubs.

3.15 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.16 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before mulching of planting beds, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.17 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 329300

SECTION 333000

SANITARY SEWERAGE UTILITIES

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 Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials, and equipment necessary to construct the sanitary sewer system complete, including connection to existing structures and testing, as indicated on the Drawings and as specified.

B. Unless otherwise indicated on the Drawings, building sewer service lines shall be installed from a point 10 feet outside the building foundation walls to the point of disposal.

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

1. Section 311000 – SITE CLEARING for site clearing, removal of trees, stumps and other vegetation, topsoil stripping, stockpiling, clearing and grubbing, and removal of site surface and utility improvements.

2. Section 312000 – EARTH MOVING for excavation, backfill, and compaction required for sanitary sewerage system piping and structures.

3. Section 221316 – SANITARY WASTE AND VENT PIPING for building sanitary drain and vent requirements.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product Data: Submit manufacturer’s technical product data and installation instructions for sanitary sewer system materials and products.

2. Submit descriptive literature for piping, fittings, couplings, and appurtenances showing dimensions, pipe and joint materials, and other details for each class or type of pipe or product to be furnished for this contract. All pipe furnished under the contract shall be manufactured in accordance with these Specifications.

3. Shop Drawings: The precast concrete structure shop drawing submittals for the manholes, septic tanks, dosing chambers, tight tanks, grease traps, wet wells, and valve pits shall contain erections drawings showing connections, cast-in items, waterproofing details, lifting hooks, and productions drawings showing elevations, sections, and details indicating sizes and quantities of reinforcement.

4. Submit shop drawings for structure hatches and frames and covers.

5. The Contractor shall submit buoyancy calculations for sanitary sewerage structures assuming groundwater is one (1) foot below finish grade. If buoyancy is an issue the structure(s) shall be modified to prevent uplift. All buoyancy calculations and precast concrete structure designs shall be prepared and stamped by a professional Civil Engineer licensed in the Commonwealth of Massachusetts.

6. Material Certificates: Provide copies of material certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds specified requirements.

7. Prior to the acceptance of the sanitary sewerage system, the Contractor shall submit to the Engineer, for review and approval, As-Built Drawings that indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built drawings shall be stamped and signed by a Massachusetts Licensed Land Surveyor or Licensed Professional Engineer. The as-built plans shall also be submitted electronically as an AutoCAD drawing file (release 2010 or higher).

8. Prior to the acceptance of the sanitary sewerage system, the Contractor shall submit the results of the leakage tests, pipe deflection measurements, and the video inspection reports.

1.4 REFERENCE STANDARDS

A. The following standards are applicable to the work of this Section to the extent referenced herein:

1. ASTM: American Society for Testing and Materials.

2. ANSI: American National Standards Institute.

3. Reference is made herein to the Commonwealth of Massachusetts, Department of Transportation (MassDOT), formerly Massachusetts Highway Department (MHD) Standard Specifications for Highways and Bridges, latest edition, hereinafter referred to as the “Standard Specifications”. All references to method of measurement, basis of payment, and payment items in the “Standard Specifications” are hereby deleted. References made to particular sections or paragraphs in the “Standard Specifications” shall include all related articles mentioned therein.

4. MassDOT Construction Standards, latest edition with amendments, hereinafter referred to as the “Construction Standards”.

5. Town/City Sewer Department Regulations.

1.5 EXAMINATION OF SITE AND DOCUMENTS

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 a lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation on the site.

B. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the

bidding period and formed his own conclusions as to the full requirements of the work involved.

1.6 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.

B. Utility Compliance: Comply with the City of Newton Water and Sewer Division regulations, standards, and guidelines pertaining to sanitary sewerage system installation and inspections.

C. Sanitary sewerage system installation shall be in conformance with the latest edition of TR-16, Guides for the Design of Wastewater Treatment Works.

D. Plumbing Code Compliance: Comply with the applicable portions of the latest editions of the Massachusetts Plumbing Code and National Standard Plumbing Code pertaining to the selection and installation of sanitary sewerage system materials and products.

E. Subsurface Disposal System Code Compliance: Comply with the applicable portions of the Commonwealth of Massachusetts State Environmental Code Title V, 310 CMR 15.00, latest revision and the local Board of Health Regulations pertaining to the installation of sanitary sewerage system materials and products.

F. Manufacturer's Qualifications: Firms regularly engaged in manufacturing of sanitary sewer system products of type, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

G. Installer's Qualifications: Firms with at least three years of successful installation experience on projects with sanitary sewer work similar to that required for the project.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site inspection and survey, research utility records, and verify existing utility locations and elevations. Verify that sewerage system structures and piping may be installed in compliance with Contract Drawings and referenced standards.

B. Interruption of Existing Sanitary Sewer Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to the requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Architect's written permission.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate with interior building sanitary sewerage system piping.

B. Coordinate with other utility work.

C. The Contractor is responsible for developing a sequence of work to maintain existing services in operation until the new services are operational.

D. The Contractor is responsible for coordinating and scheduling the inspection of the work by the jurisdictional authority. All permits and inspection costs and fees shall be included in the bid prices and no additional costs will be paid to the Contractor.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

A. General: Provide precast reinforced concrete structures as indicated and complying with ASTM C 478.

B. Manhole Top: Precast concrete of concentric cone, eccentric cone, or flat slab top type, as necessary for the installation as indicated in the Contract Drawings. Tops shall be designed to meet H20 loadings.

C. Base and Riser Sections: Precast concrete, with base riser section with integral floor. Diameter, base and riser thicknesses shall be as indicated on the Contract Drawings.

D. Cement: Type II.

E. Concrete strength: 4,000 psi minimum.

F. Precast concrete sections shall have tongue and groove joints.

G. Horizontal Joints: Joints between sections of concrete structures shall be sealed with a flexible, watertight joint, made with preformed butyl rubber joint sealant conforming to ASTM C990 or with a rubber gasket joint conforming to ASTM C443. Sealants and/or gaskets shall be installed in accordance with the manufacturer's written instructions.

H. Manhole Steps: Steps for manholes shall be non-skid raised edge-front steel reinforced polypropylene plastic type with at least 13-inch-wide stepping surface. Steps shall meet the requirements of ASTM C-478 and AASHTO M-199. Steel shall be 1/2-inch grade 60 conforming to ASTM A615 encapsulated with molded copolymer polypropylene. The polypropylene shall conform to ASTM D-4101. Rungs shall protrude no more than 6 inches from the wall. The portion of the legs to be embedded in the precast section shall have fins and be tapered to ensure a secure bond. Steps shall start a foot above the shelf of the manhole floor and continued twelve inches on center spacing up through the completed height of the unit. The steps shall finish no lower than twenty-four (24)-inches below the rim elevation. Placement into precast walls shall be by a method recommended by the supplier of the precast manhole sections. Steps shall be installed per the manufacturer's specifications.

I. Pipe Connections: Sewer manhole shall have pipe openings to accept the type of pipe specified. Pipe opening shall be minimum size require to receive the pipe and shall be accurately set to conform to the required line and grade. Sewer pipe shall be joined to the wall of the concrete manhole with flexible manhole sleeves as indicated on the drawings. Flexible manhole sleeves shall be cast in the walls of the manholes during the manufacturing process. Flexible manhole sleeves shall be NPC Kor-N-Seal Pipe-to-Manhole Connector as manufactured by Trelleborg Pipe Seals Milford, Inc., Milford, NH; Z-Lok as manufactured by A-Lok Products, Inc., Tullytown, PA; Tylox CIB Series Cast-In Boot Connector as manufactured by Hamilton Kent, Winchester, TN; or approved equal.

J. Waterproofing: The exterior surfaces of precast structures shall be given two heavy coats of waterproofing concrete sealer. The material shall be Aqua-Safe Concrete Sealer as manufactured by Bay Oil Company, Chicopee, MA; Bitumastic 300M as manufactured by Carboline Company, St. Louis, MO; Sonoshield HLM 5000 as manufactured by BASF Corporation Building Systems, Shakopee, MN; ConSeal CS-1800 as manufactured by Concrete Sealants, Inc., Tipp City, OH; or acceptable equivalent products. The waterproofing material shall be applied by brush or spray and in accordance with the instructions of the manufacturer. Time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat.

K. Sanitary Sewer Brick Masonry: Bricks shall be sound, hard, uniformly burned, regular, and uniform in shape and size. Underburned or salmon brick shall not be acceptable. Only whole brick shall be used.

1. Bricks for channels and shelves shall conform to ASTM C32, Grade SS except that the mean of five tests for absorptions shall not exceed 8 percent and no individual brick exceed 11 percent.

2. Brick for raising manhole frames to finished grade shall conform to ASTM C32, Grade MS.

3. Mortar shall be in conformance with ASTM C270, Type M. The mortar shall be composed of one-part Portland cement, 3-1/2 parts sand, and ¼ parts hydrated lime, by volume. Portland cement shall be ASTM C150, Type II; hydrated lime shall be Type S conforming to ASTM D207.

4. Sand shall be washed, cleaned, screened, well-graded with all particles passing a No. 4 sieve, and conform to ASTM C33.

L. In sewer manholes, the invert channel within the structure shall be an inverted arch with bricks laid as stretchers and on edge and so constructed as to conform in shape to the lower half of the pipe. The shelf in manholes shall consist of bricks laid flat and the top of the shelf shall be at the elevation of the top of the pipe, as indicated on the Contract Drawings, and shall be sloped to flow toward the channel.

M. Inverts in sewer manholes shall conform accurately to size of the adjoining pipe. Side inverts and main inverts where the direction changes shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerline of the adjoining pipe lines.

N. Sewer manholes shall be constructed with drop connections when the proposed invert of the connection is at least 2 feet above the manhole invert. All drop connections will be of the external type. The drop pipe shall be constructed of SDR 35 PVC sewer pipe. The drop piping and horizontal cleanout sections will be sized the same as the sewer main piping and shall enter the manhole at the invert elevation of the main. The drop portion of the piping shall be secured with anchor straps. The drop piping shall be encased with control density fill.

O. For all manhole depths greater than 10 feet, the inside diameter of the manholes shall be at least 5’-0”.

P. Safety landings shall be installed inside manholes greater than 16-feet in depth.

Q. When installing manholes on existing lines and when flows cannot be diverted, drop-over manholes shall be used. Drop-over manholes shall be precast with openings cast in the sidewalls of sufficient size to fit over the existing line(s) to remain in service. Drop-over manholes shall be set on a precast or cast-in-place concrete base slab. Drop-over manholes shall be manufactured to the same requirements and dimensions as standard manholes.

2.2 MANHOLE FRAMES AND COVERS

A. Frames and covers shall be of cast iron conforming to the requirements of ASTM A48, Class No. 30 and shall be manufactured by General Foundries Inc., North Brunswick, New Jersey; East Jordan Iron Works (formerly LeBaron Foundry, Inc.), East Jordan, Michigan; Neenah Foundry Company, Neenah, Wisconsin; or approved equal. Manhole covers shall be machined to fit securely and evenly on the frame. Frames and covers shall be designed to accept H20 loads, have a diamond surface finish, and frame height of 6 to 9-inches. Covers shall bear the word “SEWER” in 3-inch high letters. Covers shall be equal to Item Numbers 12665 and 12685 (6” and 8-1/8” frame heights, respectively) as manufactured by General Foundries Inc. Catalog numbers are provided to establish a standard of quality and configuration of castings.

2.3 PVC PIPE

A. General: Provide pipes of the following materials of class indicated. Provide pipe fittings and accessories of same materials and class as pipes with joining method, as indicated. The piping shall be manufactured by an established manufacturer of good reputation in the industry and in a permanent plant adapted to meet all the design requirements of the pipe.

B. PVC Sewer Pipe

1. PVC (Polyvinyl Chloride) Gravity Sewer Pipe and Fittings: ASTM D3034, SDR 35, for elastomeric gasket joints. Pipe 18 to 36 inches in diameter shall conform to ASTM F679, T-1 heavy wall. The pipe shall have a SDR ration of 35 and a pipe stiffness of 46 psi.

2. Joints: PVC pipe shall have an integral wall bell and spigot push-on joint with elastomeric gaskets secured in place in the bell of the pipe. The bell shall consist of an integral wall section with solid cross section elastomeric gasket, factory assembled, securely locked in place to prevent displacement during assembly. Pipe joints shall conform to ASTM D3212 and elastomeric gaskets shall conform to ASTM F477.

3. Spigot pipe ends shall be supplied with bevels from the manufacturer to ensure proper insertion. Each spigot end shall have an “assembly stripe” imprinted thereon to which the bell end of the mated pipe will extend upon proper joining of the two pipes.

4. PVC gravity sewer fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and spigot configurations compatible with that of the pipe.

2.4 CLEANOUTS

A. General: Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

B. The sewer cleanouts shall be minimum 6-inch diameter or sized to match the service pipe, whichever is greater. The cleanout shall be complete with a flush mount over. The cleanout

cover shall be clearly marked “SEWER” and shall be minimum eight inches in diameter or two inches greater than the cleanout size, whichever is greater. Cleanouts shall include a watertight cap.

2.5 SEWER COUPLINGS

A. Sewer Couplings shall be pressure rated at least equal to that of the pipe. The coupling sleeve shall be 1/4-inch minimum thickness elastomeric polyvinylchloride with a minimum tensile strength of 1500 psi. The sleeve shall fit snugly onto the pipe to be joined and be resistant to common chemicals present in sewerage. Adjustable pipe clamps shall consist of a slotted band that mate with the worm gear screw and a screw housing all manufactured of stainless steel, and suitable for underground service.

2.6 IDENTIFICATION

A. Detectable Underground Warning Tapes: Acid and alkali-resistant, polyethylene plastic film warming tape, 6-inches wide by 4-mils. minimum thickness, with continuously printed caption in black letters “CAUTION – xxxxx LINE BURIED BELOW.” The text and color of the tape shall be as shown in the table below. The tape shall have a metallic core encased in a protective jacket for corrosion protection and be detectable by a metal detector when the tape is buried up to 2.5 feet deep.

Color	Utility
Safety Red	Electric
High Visibility Safety Yellow	Gas, Oil, Steam
Safety Alert Orange	Telephone, Communications, Cable Television
Safety Precaution Blue	Water System, Irrigation
Safety Green	Sanitary Sewer, Storm Sewer

PART 3-EXECUTION

3.1 GENERAL INSTALLATION

A. General Locations and Arrangements: Contract Drawings indicate the general location and arrangement of the underground sanitary sewer system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical. Any modifications to the layout of the sewer system shall be submitted to the Engineer for review and approval at least five days prior to the start of the affected work.

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations, accepted practices, and utility owner’s requirements. Maintain swab or drag in line and pull past each joint as it is completed.

C. All piping shall be laid in the dry. Adequate measures shall be taken to prevent floatation of pipe in the trench.

D. Whenever encountered within the trench, existing abandoned water, sewer, and/or drain lines shall be removed within the trench limits, unless otherwise noted. The remaining portion of the abandoned lines shall be plugged at all open ends.

E. When bell and spigot pipes are used, bell holes shall be dug in the bedding to accommodate the bells. They shall be deep enough to ensure that the bell does not bear on the bottom of the hole but shall be excessively wide in the longitudinal direction of the installation.

F. Use manholes for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.

G. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited without the written approval of the Engineer.

H. Install piping pitched down in direction of flow as indicated on the Contract Drawings.

I. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated on the Contract Drawings.

J. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

K. Acceptance of Pipe: Acceptance will be on the basis of tests specified herein before. The quality of all materials used in the pipe, the process of manufacture, and the finished pipe shall be subject to review by the Engineer. Inspection may be made at the place of manufacture, or on the work site after delivery or at both places and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though sample pipe units may have been accepted as satisfactory at the place of manufacture. All pipe which is rejected shall be immediately removed from the project site by the Contractor.

L. Pipe Storage: Pipe sections shall not be stored on areas over the newly laid pipe or other pipelines which might be damaged by the superimposed load, and storage sections shall be restricted to approved areas.

M. Handling Pipe: Each pipe unit shall be handled into its position in the trench only in such manner and by such means, as the Engineer accepts as satisfactory. The Contractor will be required to furnish suitable devices to permit satisfactory support of all parts of the pipe unit when it is lifted.

N. Laying Pipe: Except where a concrete cradle or envelope is required, the pipe shall be laid in a crushed stone cradle. In trenches, no blocking or supporting of the piping by concrete, stones, bricks, wooden wedges, or method other than bedding the pipe on crushed stone will be permitted. Each length of pipe shall be shoved home against the pipe previously laid and held securely in position. Joints shall not be "pulled" or "cramped" without approval of the Engineer.

O. Jointing Pipe: After the pipe are aligned in the trench and are ready to be jointed, all joint surfaces shall be cleaned.

P. Alignment and Placement: All pipe shall be laid with extreme care as to grade and alignment. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

1. Stakeout of drain work and setting of line and grade is the responsibility of the Contractor.

2. The Contractor shall establish centerline and offset stakes at each manhole, plus one intermediate centerline and offset stake as a check point between manholes. Laser aligning shall not be used to establish a continuous line in excess of 400-feet.

Q. Cleaning: Care shall be taken to prevent earth, water, and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water, and debris from entering any existing sewer system.

1. Place plugs in end of uncompleted conduit at end of day or whenever work stops.

2. Flush lines between manholes to remove collected debris.

R. Review of Completed Sanitary Sewer System: The completed sewer system shall be visually inspected by the Owner's Representative. If the visual observation of the completed sewer or any part thereof shows any pipe, manhole, or joint to be of defective work or material, the defect shall be replaced or repaired as directed by the Engineer or the Owner's Representative. The Contractor shall coordinate and provide site access for inspection. All repairs or replacement of deficient or incomplete work shall be performed by the Contractor at no cost to the Owner.

3.2 INSTALLATION OF SEWER MANHOLES

A. The bases shall be supported on a compacted level foundation of gravel borrow a minimum of 12 inches thick. Crushed stone may be substituted for gravel borrow if field conditions at the bottom of the excavation are wet.

B. The Contractor shall install the manholes as soon as the pipe laying reaches the location of the manhole.

C. The Contractor shall accurately locate each manhole and set accurate templates to conform to the required line and grade. Any manhole which is not installed in the correct location or oriented improperly shall be removed and rebuilt in its proper location, alignment, and orientation at no additional cost to the Owner.

D. Manhole risers and tops shall be installed using approved butyl rubber sealant or rubber gasket for sealing joints of manhole risers and tops; jointing shall be performed in accordance with the manufacturer's recommendations. Manhole risers and tops shall be installed level and plumb. Water shall not be permitted to rise over newly made joints, nor until after inspection as to their acceptability. All jointing shall be done in a manner to ensure watertight joints.

E. Openings shall be provided in the precast concrete manhole risers to receive entering pipes and these openings shall be made at the place of manufacture. Connection of sanitary pipes to manholes shall be made by means of a flexible rubber sleeve/boot cast integral with the structure sidewall.

F. Care shall be taken to ensure the openings are made to permit setting of the entering pipe at its correct elevation as indicated or directed. Manhole risers and tops shall be installed so the manhole steps shall be in alignment.

G. All holes used for handling shall be thoroughly plugged with non-shrink grout.

H. Cutting or tampering in the field, for purpose of creating new sidewall openings or altering existing openings, will not be permitted without approval of the Engineer.

I. All interior manhole joints where the sealing material is not flush with the inside wall shall be grouted with non-shrink mortar and finished by hand/wet-brush.

J. Clean all debris, mortar, and soil from the bottom of all structures prior to final acceptance of the project.

3.3 SETTING MANHOLE FRAMES AND COVERS

A. Manhole frames shall be set with tops conforming accurately to the grade of the pavement or finished ground surface as indicated on the Contract Drawings or as directed.

B. Brick shall be used to bring the frame and cover to the required elevation.

1. Frames shall be set concentric with the opening in the top of the manhole on two to four courses of brick in a full bed of mortar. A thick ring of mortar extending to the outer edge of brick or concrete shall be placed all around the bottom flange of the cast iron frame. The mortar shall be smoothly finished to a height of 5 inches above the flange for 8-inch frames and sloped to shed water away from the frame.

2. Completed brick installation shall be coated with mortar at least a ¾ inch thick on the outside to provide a fully sealed and watertight collar between the top manhole section and the cover frame.

3. Only clean bricks shall be used in brick work to adjust frame elevations. The brick shall be moistened by suitable means.

C. The castings of structures located within the pavement area shall not be completely set to the established grade until the bottom course of pavement has been laid. The final setting of all other casting shall be performed at the proper stage of construction.

D. Manhole covers shall be left in place in the frame until completion of other work at the manholes.

3.4 PVC PIPE

A. General: Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

B. PIPE HANDLING

1. All pipe and fittings shall be carefully handled from the truck onto the ground and into the trench or excavation so as to prevent damage to the pipe. Pipes shall be kept free of dirt and foreign material especially on the inside. Joint ends of pipe shall especially be kept clean.

2. Pipe stored on site shall be protected from direct sun light and suitably ventilated.

3. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.

C. ALIGNMENT AND PLACEMENT OF PVC PIPE

1. Bedding material for the pipe must be installed with care in the area around the pipe. Bedding material must be placed to provide uniform and adequate support under pipe. Do not use blocking to bring pipe up to grade.

2. Provide bell holes at each joint to permit joint to be assembled properly while maintaining uniform pipe support.

3. Place and consolidate the bedding material under the pipe haunch to provide adequate side support while avoiding both vertical and lateral displacement of pipe.

4. Initial backfill must be completed to a point at least 12-inches over the top of the pipe and be hand placed. Use little or no tamping of initial backfill directly over the top of pipe. Compaction methods may be utilized during final backfilling.

5. No length of pipe shall be laid until the proceeding lengths of pipe have been thoroughly embedded in place, to prevent movement or disturbance of the pipe alignment.

6. Full lengths of pipe shall be used in the installation except that partial lengths may be used at the entrance to structures, and to accommodate the required locations of service connection fittings.

7. Pipe entrances to structures shall be cut flush with the inside face of the structure, and cut ends of the pipe surface within the structure shall be properly rounded and finished so that there will be no protrusion, ragged edges or imperfections that will impede or affect the hydraulic characteristics of the sewage flow. The method of cutting and finishing shall be subject to the approval of the Engineer.

8. The Contractor shall protect the installation at all times during construction. The movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Contractor's own risk.

9. Sewer pipes shall be laid to the required grades by use of a laser and target system, unless otherwise specifically approved by the Engineer.

10. Separation Between Sewer Lines and Water Lines:

    a. A minimum horizontal separation of ten (10) feet shall be maintained between proposed sewer lines and existing water lines. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, it is permitted to install a sewer line closer to a water line, provided that the sewer line is laid in a separate trench or on an undisturbed earth shelf located eighteen (18) inches above the top of sewer. In either case, the elevation of the top of the sewer shall be at least 18 inches below the bottom of the water line.

    b. Whenever sewers must cross under water lines, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water line. When the elevation of the sewer cannot be varied to provide the 18 inches of vertical clearance, the water line shall be relocated to provide this separation or reconstructed with mechanical –joint pipe for a distance of 10 feet on each side of the sewer. One full length of water pipe shall be centered over the sewer so that both joints will be as far from the sewer as possible.

c. When it is impossible to obtain horizontal and/or vertical separation as indicated above, both the water line and sewer line shall be constructed of mechanical joint ductile iron pipe for a distance of ten (10) feet to either side of the respective centerline. The water line shall be cement lined and the sewer line shall be provided with ceramic epoxy lining for sewer applications. Both pipes shall be pressure tested by an approved method to assure water-tightness or both pipes shall be encased in control density fill. One (1) full length of water pipe shall be centered over the sewer at the crossing.

11. Jointing of PVC sewer pipe and fittings shall be done in accordance with the printed recommendations of the manufacturer and as specified. The bell end of the pipe shall be thoroughly cleaned. The joint surfaces and the gasket shall be lubricated prior to making up the joint. The position of the gasket shall be checked to ensure the joint has been properly made and is watertight. Care shall be taken not to exceed the manufacturer's recommended maximum deflection allowed for each joint.

12. PVC pipe shall be pushed home by hand or with the use of bar and block. The use of power equipment, such as a backhoe bucket, is not acceptable.

13. Field-cut pipe ends shall be cut square and the pipe surface beveled to the size and shape of a factory-finished beveled end. All sharp edges shall be rounded off.

14. Detectable warning tape shall also be installed 2-feet below the existing ground surfaces for later use in locating the pipe's exact position.

3.5 CLEANOUTS

A. Install cleanouts and extensions from sewer pipe to grade as indicated on the Contract Drawings. Set cleanout frame and cover in concrete 18 by 18 by 6-inches deep, except where location is in bituminous or concrete paving. Set top of cleanout 1-inch above surrounding earth grade or flush with grade when installed in paving.

3.6 SEWER COUPLINGS

A. Couplings which are factory manufactured shall be installed at all connections from existing pipe to proposed pipe unless the existing pipe is the same material as the proposed pipe and the bell and spigot end of the pipes to be connected are compatible and free from defects. All sewer couplings shall be installed in accordance with the manufacturer’s recommendations for the types of pipe to be connected.

3.7 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work. The contractor shall verify the location, size, invert, and type of existing pipes at all points of connection prior to make the connections.

B. Make branch connections from side into existing piping by installing a wye or T-wyes, and couplings manufactured for use with the same type of pipe as indicated on the Contract Drawings. The Contractor shall install a 45° wye branch or 90° tee fittings in the sewer pipe at all locations where building sewer service pipe connections are shown on the Drawings. Connections of the sewer service pipes shall be made into the wye branches or tees by means of 45° bends. The connections shall be made thoroughly watertight and concrete

shall be placed under each connection to bear on undisturbed earth and firmly support the connection.

C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

D. Connections into existing sewer facilities shall be performed in accordance with the requirements of the City of Newton. The Contractor shall comply with all such requirements, including securing of all required permits and paying the costs thereof.

3.8 INSTALLATION OF IDENTIFICATION

A. Install continuous plastic underground warning tape during back-filling of trench for underground sanitary sewerage system piping. Locate tape two-feet below finished grade, directly over piping.

3.9 BACKFILLING

A. General: Conduct excavation and backfill operations for structure and pipe installations in accordance with Section 312000 – EARTH MOVING, local requirements, and the contract documents.

B. Initial backfill shall be placed evenly on both sides of the pipe to distribute the load and not to cause movement or deflection of the pipe.

3.10 FIELD QUALITY CONTROL

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction and the following:

1. Testing shall be witnessed by the Owner's Representative and the local authority.

2. The test shall be by vacuum or by water exfiltration as described herein:

3. Vacuum Testing of Precast Concrete Manholes

a. The vacuum test shall be conducted on each manhole in accordance with ASTM C1244. Test results will be judged by the length of time it takes for the applied vacuum to drop from 10 inches of mercury to 9 inches. If the time is less than that listed in Table 1 of ASTM C1244, the manhole will have failed the test. Test times from Table 1 are excerpted below.

TABLE 1

Minimum Test Times for Various Manhole Diameters

	Diameter (Inches)		
Depth (Feet)	48	60	72
	Times (Seconds)		
0-12	30	39	49
12-16	40	52	67

16-20	50	65	81
20-24	59	78	97
26-30	74	98	121

b. If the manhole fails the initial test, the Contractor shall locate the leaks and make the proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material. If the manhole should again fail the vacuum test, additional repairs shall be made, and the manhole water tested as specified below.

4. Water Exfiltration Testing of Precast Concrete Manholes

a. After the manhole has been assembled in place, all lifting holes shall be filled and pointed with an approved non-shrinking mortar. All pipes and other openings into the manhole shall be suitably plugged and the plugs braced to prevent flow out. The test shall be made prior to placing the shelf and invert. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test.

b. The manhole shall be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole may be considered to be satisfactorily water tight. If the test, as described above, is unsatisfactory as determined by the Owner's Representative and/or the City of Newton's Inspector or if the manhole excavation has been backfilled, the test shall be continued. A period of time may be permitted if the Contractor so wishes, to allow for absorption by the manhole. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and a measuring time of at least 8 hours begun. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour loss rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed one gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, repairs by approved methods may be made as required by the Owner's Representative and/or City of Newton's Inspector to bring the leakage within the allowable rate of one gallon per foot per day. Leakage due to a defective section or joint or exceeding the 3 gallons per vertical foot per day shall be cause for rejection of the manhole. It shall be the Contractor's responsibility to uncover the rejected manhole as necessary and to disassemble, reconstruct or replace it as required by the Owner's Representative. The manhole shall then be retested and, if satisfactory, interior joints shall be filled and pointed.

c. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorption, etc. It shall be assumed that all loss of water during the test is a result of leaks through joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the Owner's Representative and/or City of Newton's Inspector that the water table is below the bottom of the manhole throughout the test.

d. If the groundwater table is above the highest joint in the manhole, and there is no leakage into the manhole, as determined by the Owner's Representative and/or the City of Newton's Inspector, such a test can serve to evaluate water-tightness of the manhole. However, if the Owner's Representative and/or the City of

Newton's Inspector is not satisfied with the results, the Contractor shall lower the water table and carry out the test as described hereinbefore.

5. Leakage Testing of Gravity Sewer Piping and Fittings

   a. On completion of a section of sewer, including building connections, the Contractor shall install suitable bulkheads as required, dewater and test the sewer for leakage.

   b. Unless otherwise approved, the section shall be tested using low-pressure air test procedures. If circumstances permit, the Owner's Representative and/or the City of Newton's Inspector may allow testing by infiltration or exfiltration in lieu of air testing.

   c. The air test procedures shall conform to the Uni-Bell Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe, UNI-B-6. The starting air pressure for the test shall be 4 psig (greater than the average groundwater back pressure of any groundwater above the pipe, but not greater than 9.0 psig). The minimum duration permitted for the prescribed low-pressure air exfiltration pressure drop between two consecutive manholes shall not be less than provided in Table I or Table II of UNI-B-6. Note that UNI-B-6 suggests that use of the 0.5 psig pressure drop is more efficient since the time requirements are half of the 1.0 psig-pressure drop.

   d. Using the air pressure test, if there has been no leakage (zero psig drop) after one hour of testing, the section undergoing test shall have passed.

   e. If either infiltration or exfiltration testing is permitted by the Engineer, the test shall be conducted for at least 24 hours. The amount of infiltration or exfiltration shall not exceed 100 gallons per inch diameter per mile of sewer per 24 hours.

   f. The infiltration test measures leakage into a section of sewer and may be used only where the groundwater level is one foot or more above the crown of the section of sewer pipe at its upper end and at least one foot above the top of building connections and chimneys. For making the infiltration tests, underdrains, if used, shall be plugged and other groundwater drainage shall be stopped to permit the groundwater to return to its normal level insofar as practicable. Allowances shall be made for water that may enter the sewer through pipe connections and inlets during the infiltration test.

   g. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the exfiltration test may be used. The sewers shall be subjected to an internal pressure by plugging the pipe at the lower end and then filling the pipelines and manholes with clean water to a height of 2 feet above the highest point in the system to be tested, including main pipeline, service connections, and chimneys. When slopes between manholes are steep, the Contractor shall ensure that this test can be accomplished without danger of forcing stoppers from wye or tee branches.

   h. The rate of exfiltration from the sewers shall be determined by measuring the amount of water required to maintain the water level at the elevation established at the beginning of the test

i. The Contractor shall construct such weirs or other means of measurements as may be required, shall furnish water, and shall do all necessary pumping to enable the test to be properly made.

j. The Contractor shall be responsible for the satisfactory water-tightness of the entire section of sewer. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing leaks and retesting as the Engineer may require without additional compensation. A plan of the method of repairing any leaks that are found shall be submitted to the Engineer for review.

6. Pipe Deflection Measurement

a. In accordance with ASTM D3034, no less than 30 days after completion of the PVC sewer pipe installation, the Contractor shall test the pipeline for deflection using a "go/no go" deflection mandrel having a minimum of nine evenly spaced arms or prongs. The "go/no go" gauge shall be hand pulled through all sections of the pipeline by the Contractor. The Contractor shall submit drawings of the "go/no go" gauge to the Owner's Representative and/or the City of Newton's Inspector for approval prior to testing. Complete dimensions of the gauge for each diameter of pipe to be tested shall be in accordance with ASTM D3034.

b. Any section of pipe found to exceed 7.5 percent deflection shall be deemed a failed pipe and shall be excavated and replaced by the Contractor at his own expense.

7. Video Inspections: Seven days after the completion of the backfilling of each section of new pipe, as defined as a length of pipe between two manholes, the Contractor shall provide a televised inspection of the pipe to be submitted to the Designer. The Owner's Representative shall be present during the recording. The recording shall be in DVD color format with audio and shall show a clear picture of the inside of the new pipe. If the Designer determines that the DVD is unacceptable for review the contractor shall re-televise the line until an acceptable DVD has been submitted. In the event that the pipe is not acceptable for any reason relating to the proper construction of the pipe according to these specifications, the Contractor will be responsible to re-excavate and repair the defects to the satisfaction of the Designer at no additional cost.

B. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.

2. Place watertight plugs in ends of uncompleted pipe at end of day or whenever work stops. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe eliminated.

3. Flush piping between manholes to remove collected debris.

C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

1. Make inspections after pipe between manholes has been installed and approximately 2 feet of backfill is in place, and again at completion of project.

2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, the Contractor shall correct such defects and reinspect.

D. Prior to acceptance of the sanitary sewerage system, the Contractor shall submit the following to the Architect and to the local authority:

1. System As-Built Plan stamped by a Professional Land Surveyor or Engineer Registered in the Commonwealth of Massachusetts.

2. Video inspection DVDs and report: The report shall document the observations of the video inspections.

3. Deflection test report: The report shall fully describe the test procedures and list the test results. The report shall be signed by the Contractor's superintendent.

4. Leakage test report: The report shall fully describe the test procedures and list the test results. The report shall be signed by the Contractor's superintendent.

3.11 FINAL INSPECTION

A. Final inspection and acceptance of the sanitary sewer system shall be made by the Owner's Representative and the utility owner having jurisdiction of the particular system.

B. Prior to placing the systems in service, all components shall be inspected, with the Owner's Representative present, to ensure that no debris or other contaminants are present. If necessary, the Contractor shall clean the structures and flush piping.

C. The Contractor is responsible for coordinating and scheduling the inspection of the work by local jurisdictional authorities. No additional payment will be made for inspections and permits required in the performance of the work.

END OF SECTION

SECTION 334000

STORM DRAINAGE UTILITIES

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 Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials, and equipment necessary to construct the storm drainage system complete, including connections to existing structures and testing, as indicated on the Drawings and as specified.

B. Unless otherwise indicated on the Drawings, building drain service lines shall be installed from a point 10 feet outside the building foundation walls to the point of disposal.

C. Related Work: The following items are noted and included in this Section and will be performed under the designated sections:

1. Section 312000 – EARTH MOVING for excavation, backfill, & compaction requirements.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product Data: Submit manufacturer's technical product data and installation instructions for storm drain system materials and products.

2. Submit descriptive literature for piping, fittings, couplings, and appurtenances showing pipe dimensions, pipe and joint materials and dimensions, and other details for each class or type of pipe or product to be furnished for this contract. All pipe furnished under the contract shall be manufactured in accordance with these Specifications.

3. Submit shop drawings for storm drain systems, showing piping and manhole materials and sizes.

4. Submit shop drawings of complete layout of detention/retention structures, including all fittings and appurtenances.

5. The precast concrete structure shop drawing submittals for the manholes, catch basins, vaults, and tanks shall contain erection drawings showing connections, cast-in items, waterproofing details, lifting hooks, and production drawings showing elevations, sections, and details indicating sizes and quantities of reinforcement.

6. Submit shop drawings for structure frames, grates, and covers.

7. Filter fabric: Submit the manufacturer's information.

8. For trench drains submit shop drawings showing a schematic plan of the entire trench drain system, listing all parts being provided with exact centerline dimensions suitable for installation. Copies of the manufacturer's recommended method of installation and assembly shall be submitted for review.

9. For water quality structures and stormwater quality filter treatment structures submit shop drawings for the structure and performance. Shop drawings shall detail the structures precast concrete components, inserts, and castings. Where an external bypass is required, the manufacturer shall provide calculations and designs for all structures, piping and any other required material applicable to the proper functioning of the system, stamped by a Professional Engineer.

10. The Contractor shall submit buoyancy calculations for storm drainage structures assuming groundwater is one (1) foot below finish grade. If buoyancy is an issue the structure(s) shall be modified to prevent uplift. All buoyancy calculations and precast concrete structure designs shall be prepared and sealed by a professional Civil Engineer licensed in the state of Massachusetts.

11. Prior to the acceptance of the storm drainage system, the Contractor shall submit to the Engineer, for review and approval, As-Built Drawings that indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built drawings shall be stamped and signed by a Massachusetts Licensed Land Surveyor or Licensed Professional Engineer. The as-built plans shall also be submitted electronically as an AutoCAD drawing file (release 2010 or higher).

12. Prior to acceptance of the storm drainage system, the Contractor shall submit the results of the pipe deflection measurements and the video inspection reports.

1.4 REFERENCE STANDARDS

A. The following standards are applicable to the work of this Section to the extent referenced herein:

1. ASTM: American Society for Testing and Materials.

2. ANSI: American National Standards Institute.

3. AASHTO: American Association of State Highway and Transportation Officials.

4. Reference is made herein to the Commonwealth of Massachusetts, Department of Transportation (MassDOT), Formerly Massachusetts Highway Department (MHD) Standard Specifications for Highways and Bridges, latest edition, hereinafter referred to as the "Standard Specifications". All references to method of measurement, basis of payment, and payment items in the "Standard Specifications" are hereby deleted. References made to particular sections or paragraphs in the "Standard Specifications" shall include all related articles mentioned therein.

5. MassDOT Construction Standards, latest Edition with amendments, hereinafter referred to as the "Construction Standards."

1.5 EXAMINATION OF SITE AND DOCUMENTS

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 a

lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation of the site.

B. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

1.6 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm drain systems.

B. Utility Compliance: Comply with the City of Newton regulations, standards, and guidelines pertaining to storm drainage system installation and inspections.

C. Plumbing Code Compliance: Comply with applicable portions of Massachusetts Plumbing Code and National Standard Plumbing Code, latest editions, pertaining to selection and installation of storm drain system's materials and products.

D. Manufacturer's Qualifications: Firms regularly engaged in manufacturing of storm drain system's products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

E. Installer's Qualifications: Firms with at least three years of successful installation experience on projects with storm drain work similar to that required for the project.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site inspection and survey, research utility records, and verify existing utility locations and elevations. Verify that storm drainage system structures and piping may be installed in compliance with Contract Drawings and referenced standards.

B. Interruption of Existing Storm Drainage System: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to the requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Architect’s written permission.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate with interior building storm drain system piping.

B. Coordinate with other utility work.

C. The Contractor is responsible for developing a sequence of work to maintain existing services in operation until the new services are operational.

D. The Contractor is responsible for coordinating and scheduling the inspection of the work by the jurisdictional authority. All permits and inspection costs and fees shall be included in the bid prices and no additional costs will be paid to the Contractor.

PART 2 – PRODUCTS

2.1 MANHOLES AND CATCH BASINS

A. General: Provide precast reinforced concrete structures as indicated and complying with ASTM C 478.

B. Manhole Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated in the Contract Drawings. Tops shall be designed to meet H20 loadings.

C. Base and Riser Sections: Precast concrete, with base riser section with integral floor. Diameter, base and riser thicknesses shall be as indicated on the Contract Drawings.

D. Cement: Type II.

E. Concrete strength: 4,000 psi minimum.

F. Precast concrete sections shall have tongue and groove joints.

G. Horizontal Joints: Joints between sections of concrete structures shall be sealed with a flexible, watertight joint, made with preformed butyl rubber joint sealant conforming to ASTM C990 or with a rubber gasket joint conforming to ASTM C443. Sealants and/or gaskets shall be installed in accordance with the manufacturer's written instructions.

H. Manhole Steps: Steps for manholes shall be non-skid raised edge-front steel reinforced polypropylene plastic type with at least 13-inch-wide stepping surface. Steps shall meet the requirements of ASTM C-478 and AASHTO M-199. Steel shall be 1/2-inch grade 60 conforming to ASTM A615 encapsulated with molded copolymer polypropylene. The polypropylene shall conform to ASTM D-4101. Rungs shall protrude no more than 6 inches from the wall. The portion of the legs to be embedded in the precast section shall have fins and be tapered to ensure a secure bond. Steps shall start a foot above the shelf of the manhole floor and continued twelve inches on center spacing up through the completed height of the unit. The steps shall finish no lower than twenty-four (24)-inches below the rim elevation. Placement into precast walls shall be by a method recommended by the supplier of the precast manhole sections. Steps shall be installed per the manufacturer's specifications.

I. Pipe Connections: Drainage structures shall have plain beveled openings to accept the type of pipe specified. Pipe openings shall be minimum size required to receive the pipe and shall be accurately set to conform to the required line and grade. Drain pipe shall be joined to the wall of the concrete manhole or catch basin with non-shrink grout or flexible manhole sleeve as indicated on the drawings. Grout mixture shall follow instructions provided by manufacturer. Flexible manhole sleeves shall be cast in the walls of the manholes during the manufacturing process. Flexible manhole sleeves shall be NPC Kor-N-Seal Pipe-to-Manhole Connector as manufactured by Trelleborg Pipe Seals Milford, Inc., Milford, NH; Z-Lok as manufactured by A-Lok Products, Inc., Tullytown, PA; Tylox CIB Series Cast-In Boot Connector as manufactured by Hamilton Kent, Winchester, TN; or approved equal.

J. Waterproofing: The exterior surfaces of precast structures shall be given two heavy coats of waterproofing concrete sealer. The material shall be Aqua-Safe Concrete Sealer as manufactured by Bay Oil Company, Chicopee, MA; Bitumastic 300M as manufactured by Carboline Company, St. Louis, MO; Sonoshield HLM 5000 as manufactured by BASF Corporation Building Systems, Shakopee, MN; ConSeal CS-1800 as manufactured by Concrete Sealants, Inc., Tipp City, OH; or acceptable equivalent products. The waterproofing material shall be applied by brush or spray and in accordance with the

instructions of the manufacturer. Time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat.

K. Storm Drainage Brick Masonry: Bricks shall be sound, hard, uniformly burned, regular, and uniform in shape and size. Underburned or salmon brick shall not be acceptable. Only whole brick shall be used.

1. Bricks for raising manhole and catch basin frames to finished grade shall conform to ASTM C32, Grade MS.

2. Mortar shall be in conformance with ASTM C270, Type M. The mortar shall be composed of one-part Portland cement, 3-1/2 parts sand, and ¼ parts hydrated lime, by volume. Portland cement shall be ASTM C150, Type II; hydrated lime shall be Type S conforming to ASTM D207.

3. Sand shall be washed, cleaned, screened, well-graded with all particles passing a No. 4 sieve, and conform to ASTM C33.

L. Inverts in drain manholes shall be constructed of cement concrete shaped to conform accurately to size of the adjoining pipe. Side inverts and main inverts where the direction changes shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerline of the adjoining pipe lines.

M. For all manhole depths greater than 10 feet, the inside diameter of the manholes shall be at least 5'-0".

N. Safety landings will be installed inside manholes greater than 16-feet in depth.

O. When installing manholes on existing lines and when flows cannot be diverted, drop-over manholes shall be used. Drop-over manholes shall be precast with opening cast in the sidewalls of sufficient size to fit over the existing line(s) to remain in service. Drop-over manholes shall be set on a precast or cast-in-place concrete base slab. Drop-over manholes shall be manufactured to the same requirements and dimensions as standard manholes.

2.2 MANHOLE FRAMES AND COVERS

A. Frames and covers shall be of cast iron conforming to the requirements of ASTM A48, Class No. 30 and shall be manufactured by General Foundries Inc., North Brunswick, New Jersey; East Jordan Iron Works (formerly LeBaron Foundry, Inc.), East Jordan, Michigan; Neenah Foundry Company, Neenah, Wisconsin; or approved equal. Manhole covers shall be machined to fit securely and evenly on the frame. Frames and covers shall be designed to accept H20 loads, have a diamond surface finish, and frame height of 6 to 9-inches. Covers shall be equal to Item Numbers 12665 and 12685 (6" and 8-1/8" frame heights, respectively) as manufactured by General Foundries Inc. Catalog numbers are provided to establish a standard of quality and configuration of castings. Covers shall bear the word "DRAIN" in 3-inch-high letters.

2.3 CATCH BASIN FRAMES AND GRATES

A. Catch basin grates located at low points shall consist of a 24-inch square grate with a minimum frame height of 8 inches unless otherwise noted on the drawings. Frames and grates shall be of cast iron and designed to accept H20 loads. Catch Basin Frames and Grates shall be manufactured by General Foundries Inc., North Brunswick, New Jersey; East Jordan Iron Works (formerly LeBaron Foundry, Inc.), East Jordan, Michigan; Neenah Foundry Company, Neenah, Wisconsin; or approved equal. Single frames and grates shall

be equal to Item Numbers 22444-SQH, 22464-SQH, and 22484-SQH (4", 6", and 8" frame heights, respectively) as manufactured by General Foundries Inc. ADA Compliant frames and grates shall be equal to Item Numbers 22444-ADA, 22464-ADA, and 22484-ADA (4", 6", and 8" frame heights, respectively) as manufactured by General Foundries Inc. Double frames and grates shall be equal to Item Numbers 24844-SQH, 24864-SQH, and 24884-SQH (4", 6", and 8" frame heights, respectively) as manufactured by General Foundries Inc. Four and three-flange frames shall be provided as required. Catalog numbers are provided to establish a standard of quality and configuration of castings.

B. Catch basin cascade frames and grates shall consist of a 24-inch square grate with a minimum frame height of 8 inches unless otherwise noted on the drawings. Frames and grates shall be of cast iron and designed to accept H20 loads. Cascade frames and grates shall be manufactured by General Foundries Inc., North Brunswick, New Jersey; East Jordan Iron Works (formerly LeBaron Foundry, Inc.), East Jordan, Michigan; Neenah Foundry Company, Neenah, Wisconsin; or approved equal. Cascade frames and grates shall be equal to Item Numbers 22444-CAS, 22464-CAS, and 22484-CAS (4", 6", and 8" frame heights, respectively) as manufactured by General Foundries Inc. Four and three-flange frames shall be provided as required. Catalog numbers are provided to establish a standard of quality and configuration of castings.

2.4 CATCH BASIN HOODS

A. All catch basins shall have hoods installed over the outlet pipe. Hoods shall be cast iron removable or hinged traps that fit over the catch basin outlet pipe. Traps shall be approximately 19-inches wide by 18-inches high and extend 11-inches from the wall of the structure. Catch Basin Hoods shall be manufactured by General Foundries Inc., North Brunswick, New Jersey; East Jordan Iron Works (formerly LeBaron Foundry, Inc.), East Jordan, Michigan; Neenah Foundry Company, Neenah, Wisconsin; or approved equal. Hoods shall be equal to Item Number MATRP as manufactured by General Foundries Inc. Catalog numbers are provided to establish a standard of quality and configuration of castings.

2.5 WATER QUALITY STRUCTURE

A. The water quality drainage structure models indicated on the Contract Drawings are Stormceptor® as manufactured by the Stormceptor Corporation, Rockville, MD. Equivalent structures include Vortechs as manufactured by Vortechnics, Inc. of Portland, ME, and Downstream Defender as manufactured by Hydro International of Portland, ME. Other acceptable equivalent manufactured devices may be used if following requirements are met. Prior to acceptance, the contractor shall receive written approval for use of said substitution from the City of Newton and/or their authorized representatives.

B. The water quality structure shall have a proven laboratory test record of having the capability to remove a minimum of 80% of the sediment load from the low-flow storm conditions from the total catchment area of the drainage system. Laboratory testing methods shall conform to the "Technology Acceptance Reciprocity Partnership" (TARP) Tier II protocol or other acceptable equivalent method and shall have the capability of removing clay and silt size particles.

C. The available water quality structure laboratory performance documentation shall achieve a grade of "2" or better as rated through the "Massachusetts Stormwater Evaluation Project" (MAStep).

D. The water quality structure shall be installed underground as part of the stormwater system.

E. The structure shall be constructed of precast concrete components.

F. Precast Concrete Sections: All precast concrete components shall be designed and manufactured to a minimum live load of AASHTO HS-20 truck loading.

G. Joints: The concrete joints shall be watertight and meet the design criteria according to ASTM C443.

H. Frame and Cover: The frame and cover shall clearly indicate with lettering the unit's name cast into the cover to allow for easy identification in the field.

I. Concrete: Precast concrete components shall meet the requirements of ASTM C478.

J. Fiberglass: The fiberglass portion of the water treatment structure shall be constructed in accordance with ASTM D409, Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks. The internal fiberglass insert shall be bolted and sealed watertight inside the reinforced concrete component.

K. The water quality structure shall be vertically oriented with easy access to facilitate maintenance.

L. The first 16 inches of oil storage should be lined with fiberglass or other coating acceptable to the Engineer to provide double-wall containment of any hydrocarbon-based material.

M. Water quality structure shall be equipped with high flow bypass that shall be physically separated from the separation area to prevent mixing.

N. The structure shall be maintainable from the surface via access points without requiring entry into the structure.

O. The structure shall be designed to prevent the formation of secondary eddy currents or scour conditions.

P. The structure shall be able to be installed to the invert elevations of the drainage system as detailed on the Contract Drawings.

Q. The water quality structure shall be capable of containing floatable substances such as oil and gasoline within the structure during normal operation as well as periods of service and repair. Floatables containment shall be achieved without the use of floatable additives.

R. The water quality structure shall not be compromised by backwater conditions i.e., trapped pollutants should not be resuspended and scoured from the interceptor during backwater conditions.

S. Calculations stamped by a Professional Engineer shall be supplied to demonstrate that the water quality structures will accept the design flow rates without causing a backwater condition.

T. Inspection: All precast concrete sections shall be inspected to ensure that dimensions, appearance, and quality of the product meet the requirements of ASTM C478.

2.6 CORRUGATED POLYETHYLENE PIPE

A. General: Provide pipes of the following materials of class indicated. Provide pipe fittings and accessories of same materials and class as pipes with joining method, as indicated. The piping shall be manufactured by an established manufacturer of good reputation in the industry and in a permanent plant adapted to meet all the design requirements of the pipe.

1. Corrugated polyethylene pipe shall have an interior surface that is smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind.

    a. Pipe shall conform to AASHTO M252, Type S for 4- through 10-inch diameter pipes.

    b. Pipe shall conform to AASHTO M294, Type S or ASTM F2306 for 12- through 60-inch diameter pipes.

    c. Fittings shall conform to AASHTO M252, AASHTO M294 or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294 or ASTM F2306.

2. Pipe and fittings shall be high-density polyethylene meeting the requirements of ASTM D3350.

3. Pipe units shall have a minimum laying length of 20-feet except as otherwise indicated or allowed by the Engineer.

4. Pipe shall be installed with a minimum 12-inch cover for AASHTO H-20 loading.

B. CORRUGATED POLYETHYLENE FLARED END SECTION

1. The pipe shall have an interior surface that is smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. Flared end section shall be high-density polyethylene meeting ASTM D3350 minimum cell classification 213320C. Metal threaded fastening rods shall be stainless steel.

C. JOINTS ON CORRUGATED POLYETHYLENE PIPE

1. The pipe and fitting joints shall be bell-and spigot with watertight gaskets in accordance with the requirements of ASTM D3212.

2. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

3. Pipe entrances at catch basins shall be made with a mortar made with Type II cement. Mortar mixture shall follow instructions provided by cement manufacturer. Pipe connections at drain manholes and water quality structures shall be made with integral flexible rubber sleeves and Corrugated Pipe Adapters designed for use with the pipe and sleeves.

2.7 REINFORCED CONCRETE PIPE (CLASS IV; 12 THROUGH 48 INCHES)

A. General: Provide pipes of the following materials of class indicated. Provide pipe fittings and accessories of same materials and class as pipes with joining method, as indicated. The piping shall be manufactured by an established manufacturer of good reputation in the industry and in a permanent plant adapted to meet all the design requirements of the pipe.

1. The pipe shall have an interior surface, which is smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. Pipe shall conform to ASTM "Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe,"

Designation: C76 and shall be Wall B for the Class IV and V, as noted on the drawings, and with additions and exceptions as follows:

2. Type II cement shall be used unless otherwise approved by the Engineer. Admixtures shall not be used except with prior approval of the Engineer.

3. Elliptical reinforcement will not be permitted. Longitudinal reinforcement shall be continuous. Reinforcement shall have a minimum cover of ¾ inch. Pipe shall have no lifting holes.

4. Absorption shall be as specified under "Tests of Materials and Pipe Units."

5. Pipes manufactured by the centrifugal process or in vertical forms shall be cast of wet mix concrete. Concrete cast in vertical forms shall be consolidated by internal or external mechanical vibration or both. The vibrating equipment shall be operated at high speed (more than 5,000 rpm) and have a low amplitude. Pipes manufactured by the modified packer process shall have a supplementary concrete densification operation that shall assure the attainment of full bond between reinforcement and concrete and also eliminate any displacement of the reinforcement. Additional passes with the revolving packerhead or the use of additional vibrators attached to the platform or exterior forms will not be acceptable.

6. Pipe units shall have a minimum laying length of 8-feet except as otherwise indicated or allowed by the Engineer.

7. Pipe may be rejected for any of the following reasons:

    a. Exposure of any wires, positioning spacers or chairs used to hold the reinforcement cage in position, or steel reinforcement in any surface of the pipe, except as permitted by Section 8.2 of ASTM C76.

    b. Transverse reinforcing steel found to be in excess of 1/4-inch out of specified position after the pipe is molded.

    c. Any shattering or flaking of concrete as a crack.

    d. Voids, with the exception of a few minor bugholes, on the interior and exterior surfaces of the pipe exceeding 1/4-inch in depth, unless properly and soundly pointed with mortar or other approved material.

    e. A hollow spot (identified by tapping the internal surface of the pipe) which is greater than 30-inches in length or wider than 3 times the specified wall thickness.

    f. Defects that indicate imperfect molding of concrete; or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area equal to a square with a side dimension of 2½ times the wall thickness or deeper than two times the maximum graded aggregate size; or local deficiency of cement resulting in loosely bonded concrete.

    g. Any of the following:

        1) A crack having a width of 0.005 to 0.01-inches throughout a continuous length of 36-inches or more.

2) A crack having a width of 0.0 to 0.03-inches or more throughout a continuous length of 1-foot or more.

3) Any crack greater than 0.005-inches extending through the wall of the pipe and having a length in excess of the wall thickness.

4) Any crack showing two visible lines of separation for a continuous length 2-feet or more, or an interrupted length of 3-feet or more anywhere in evidence, both inside and outside.

5) Cracks anywhere greater than 0.03-inches in width.

h. Application of any wash coat of cement or grout to the pipe will not be permitted without approval of the Engineer. Any pipe dressing procedures shall be subject to the approval of the Engineer.

B. Joints on Reinforced Concrete Pipe:

1. Pipe joints for all reinforced concrete pipe shall be of the rubber gasket type in which the gaskets are in compression and which will permit both longitudinal and angular movement. Each unit of pipe shall be provided with proper ends made of concrete formed true to size and formed on machined rings to ensure accurate joint surfaces.

2. Joints and gaskets for pipe shall be the O-ring gasket type and shall conform to the requirements of ASTM C443 and the additional requirements specified.

3. Joints shall be of such design that when tested under an average internal hydrostatic pressure of 13 pounds per square inch for a period of 10 minutes, no visible leakage will result. The diameters of the joint surfaces which compress the gasket shall not vary from the true diameters by more than 1/16-in or the amount permitted by the appropriate above-mentioned ASTM Standard Specifications, whichever is less.

4. Gaskets shall be of a composition and texture which is resistant to common ingredients of sewage, industrial wastes, and groundwater, and which will endure permanently under the conditions likely to be imposed by this service. Gaskets shall be the product of a manufacturer regularly engaged in the manufacture of rubber gaskets for pipe joints.

C. Flared End Sections: Reinforced Concrete Pipe flared end sections shall conform to requirements of AASHTO M170, minimum Class IV.

2.8 FILTER FABRIC

A. Filter Fabric used, as a drainage medium shall consist of a non-woven fabric made from polypropylene or polyethylene filaments or yarns. The fabric shall be inert to organic chemicals commonly encountered in the soil. Edges of filter fabric shall overlap a minimum of one foot. The fabric shall conform to the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Weight	oz/sy	ASTM D-5261-92	4.8
Grab Strength	lbs	ASTM D-4632-91	120
Grab Elongation	percent	ASTM D-4632-91	50
Trapezoid Tear Strength	lbs	ASTM D-4533-91	50
Mullen Burst Strength	psi	ASTM D-3786-87	225
Puncture Strength	lbs	ASTM D-4833-00	65
Apparent Opening Size (AOS)	U.S. std. Size Sieve	ASTM D-4751-99A	70

2.9 CRUSHED STONE

A. Crushed stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, sand, clay, loam, or other deleterious or organic material. The crushed stone shall be uniformly blended and shall conform to the following requirements.

Percent Passing by Weight		
Sieve Size	3/4-inch Stone	1/2-inch Stone
1-inch	100	---
3/4-inch	90-100	---
5/8-inch	---	100
1/2-inch	10-50	85-100
3/8-inch	0-20	15-45
No. 4	0-5	0-15
No. 8	---	0-5

2.10 DRAIN COUPLINGS

A. Drain Couplings shall be pressure rated at least equal to that of the pipe. The coupling sleeve, shall be 1/4-inch minimum thickness elastomeric polyvinylchloride with a minimum tensile strength of 1500 psi. The sleeve shall fit snugly onto the pipe to be joined and be resistant to common chemicals present in storm water. Adjustable pipe clamps shall consist of a slotted band that mate with the worm gear screw and a screw housing all manufactured of stainless steel, and suitable for underground service.

2.11 CLEANOUTS

A. General: Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

B. The drain cleanouts shall be minimum 6-inch diameter or sized to match the service pipe, whichever is greater. The cleanout shall be complete with a flush mount over. The cleanout cover shall be clearly marked “DRAIN” and shall be minimum eight inches in diameter or two inches greater than the cleanout size, whichever is greater. Cleanouts shall include a watertight cap.

2.12 IDENTIFICATION

A. Detectable Underground Warning Tapes: Acid and alkali-resistant polyethylene plastic film warning tape, 6-inches wide by 4-mils. minimum thickness, with continuously printed caption in black letters "CAUTION - xxxxx LINE BURIED BELOW." The text and color of the tape shall be as shown in the table below. The tape shall have a metallic core encased in a

protective jacket for corrosion protection and be detectable by a metal detector when the tape is buried up to 2.5-feet deep.

Color	Utility
Safety Red	Electric
High Visibility Safety Yellow	Gas, Oil, Steam
Safety Alert Orange	Telephone, Communications, Cable Television
Safety Precaution Blue	Water System, Irrigation
Safety Green	Sanitary Sewer, Storm Sewer

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

A. General: General Locations and Arrangements: Contract Drawings indicate the general location and arrangement of the underground storm drainage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical. Any modifications to the layout of the storm drainage system shall be submitted to the Engineer for review and approval at least five days prior to the start of the affected work.

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations, accepted practices, and utility owner’s requirements. Maintain swab or drag in line and pull past each joint as it is completed.

C. All pipe shall be laid in the dry. Adequate measures shall be taken to prevent floatation of pipe in the trench.

D. Whenever encountered within the trench, existing abandoned water, sewer, and/or drain lines shall be removed within the trench limits, unless otherwise noted. The remaining portion of the abandoned lines shall be plugged at all open ends.

E. When bell and spigot pipes are used, bell holes shall be dug in the bedding to accommodate the bells. They shall be deep enough to ensure that the bell does not bear on the bottom of the hole but shall be excessively wide in the longitudinal direction of the installation.

F. Use manholes for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into an existing storm drain is indicated.

G. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited without the written approval of the Engineer.

H. Install piping pitched down in direction of flow as indicated on the Contract Drawings.

I. Extend storm drainage system piping to connect to building drain services, of sizes and in locations indicated on the Contract Drawings.

J. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

K. Acceptance of Pipe: Acceptance will be on the basis of tests specified herein before. The quality of all materials used in the pipe, the process of manufacture, and the finished pipe shall be subject to review by the Engineer. Inspection may be made at the place of manufacture, or on the work site after delivery or at both places and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though sample pipe units may have been accepted as satisfactory at the place of manufacture. All pipe which is rejected shall be immediately removed from the project site by the Contractor.

L. Pipe Storage: Pipe sections shall not be stored on areas over the newly laid pipe or other pipelines which might be damaged by the superimposed load, and storage sections shall be restricted to approved areas.

M. Handling Pipe: Each pipe unit shall be handled into its position in the trench only in such manner and by such means, as the Engineer accepts as satisfactory. The Contractor will be required to furnish suitable devices to permit satisfactory support of all parts of the pipe unit when it is lifted.

N. Laying Pipe: Except where a concrete cradle or envelope is required, the pipe shall be laid in a crushed stone cradle. In trenches, no blocking or supporting of the piping by concrete, stones, bricks, wooden wedges, or method other than bedding the pipe on crushed stone will be permitted. Each length of pipe shall be shoved home against the pipe previously laid and held securely in position. Joints shall not be "pulled" or "cramped" without approval of the Engineer.

O. Jointing Pipe: After the pipe are aligned in the trench and are ready to be jointed, all joint surfaces shall be cleaned.

P. Alignment and Placement: All pipe shall be laid with extreme care as to grade and alignment. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

1. Stakeout of drain work and setting of line and grade is the responsibility of the Contractor.

2. The Contractor shall establish centerline and offset stakes at each manhole, plus one intermediate centerline and offset stake as a check point between manholes. Laser aligning shall not be used to establish a continuous line in excess of 400-feet.

Q. Cleaning: Care shall be taken to prevent earth, water, and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water and debris from entering any existing drainage system.

1. Place plugs in end of uncompleted conduit at end of day or whenever work stops.

2. Flush lines between manholes to remove collected debris.

R. Review of Completed Storm Drain System: The completed drain system shall be visually inspected by the Owner’s Representative. If the visual observation of the completed drain or any part thereof shows any pipe, manhole, or joint to be of defective work or material, the defect shall be replaced or repaired as directed by the Engineer or the Owner’s Representative. The Contractor shall coordinate and provide site access for inspection.

3.2 INSTALLATION OF REINFORCED CONCRETE PIPE AND PIPE FITTINGS

A. General: Install piping in accordance with ASTM D2321, the governing authorities having jurisdiction of the utility, and the manufacturer's instructions, except where more stringent requirements are required by the Contract Documents.

B. Acceptance of Pipe: Acceptance will be on the basis of tests specified hereinbefore. The quality of all materials used in the pipe, the process of manufacture, and the finished pipe shall be subject to review by the Engineer. Inspection may be made at the place of manufacture, or on the work site after delivery or at both places and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though sample pipe units may have been accepted as satisfactory at the place of manufacture. All pipe which is rejected shall be immediately removed from the project site by the Contractor at no cost to the Owner.

C. Pipe Storage: Pipe sections shall not be stored on areas over the newly laid pipe or other pipelines which might be damaged by the superimposed load, and storage sections shall be restricted to approved areas.

D. Laying Pipe: Except where a concrete cradle or envelope is required, the pipe shall be laid in a crushed stone cradle. In trenches, no blocking or supporting of the piping by concrete, stones, bricks, wooden wedges, or method other than bedding the pipe on crushed stone will be permitted. Each length of pipe shall be shoved home against the pipe previously laid and held securely in position. Joints shall not be "pulled" or "cramped" without approval of the Engineer.

E. Jointing Pipe: After the pipes are aligned in the trench and are ready to be jointed, all joint surfaces shall be cleaned.

F. Alignment and Placement: All pipes shall be laid with extreme care as to grade and alignment. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

1. Stakeout of drain work and setting of line and grade is the responsibility of the Contractor.

2. The Contractor shall establish centerline and offset stakes at each manhole, plus intermediate centerline and offset stakes as needed to ensure proper alignment and grade. Laser aligning shall not be used to establish a continuous line in excess of 400-feet.

G. Cleaning: Care shall be taken to prevent earth, water, and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water, and debris from entering any existing Drain.

1. Place plugs in end of uncompleted conduit at end of day, or whenever work stops.

2. Flush lines between manholes to remove collected debris.

H. Review of Completed Reinforced Concrete Pipe System: If the visual observation of the completed drain or any part thereof shows any pipe, manhole, or joint to be of defective work or material the defect shall be replaced or repaired as directed at no cost to the Owner. The visual observation shall be conducted by the Engineer and any defects shall be as identified by such. The Contractor shall coordinate and provide site access for the Owner.

3.3 INSTALLATION OF CORRUGATED POLYETHYLENE PIPE AND PIPE FITTINGS

A. General: Install Corrugated Polyethylene Pipe in accordance with ASTM D2321 and governing authorities having jurisdiction, except where more stringent requirements are indicated.

B. Acceptance of Pipe: Acceptance will be on the basis of tests specified herein before. The quality of all materials used in the pipe, the process of manufacture, and the finished pipe shall be subject to review by the Engineer. Inspection may be made at the place of manufacture, or on the work site after delivery or at both places and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though sample pipe units may have been accepted as satisfactory at the place of manufacture. All pipe which is rejected shall be immediately removed from the project site by the Contractor.

C. Pipe Storage: Pipe sections shall not be stored on areas over the newly placed pipe or other pipelines which might be damaged by the superimposed load, and storage sections shall be restricted to approved areas.

D. Handling Pipe: Each pipe unit shall be handled into its position in the trench only in such manner and by such means, as the Engineer accepts as satisfactory. The Contractor will be required to furnish suitable devices to permit satisfactory support of all parts of the pipe unit when it is lifted.

E. Alignment and Placement: All pipe shall be placed with extreme care as to grade and alignment. Each pipe shall be so placed as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

1. Stakeout of drain work and setting of line and grade is the responsibility of the Contractor.

2. The Contractor shall establish centerline and offset stakes at each manhole, plus intermediate centerline and offset stake as needed to ensure proper alignment and grade between manholes. Laser aligning shall not be used to establish a continuous line in excess of 400-feet.

3. Bedding material for the pipe must be installed with care in the area around the pipe. Bedding material must be placed to provide uniform and adequate support under pipe. Do not use blocking to bring pipe up to grade. Bedding shall be crushed stone.

4. Provide bell holes at each joint to permit joint to be assembled properly while maintaining uniform pipe support.

5. Place and consolidate the bedding material under the pipe haunch to provide adequate side support while avoiding both vertical and lateral displacement of pipe.

6. Initial backfill must be completed to a point at least 12-inches over the top of the pipe and be hand placed. Use little or no tamping of initial backfill directly over the top of pipe. Compaction methods may be utilized during final backfilling.

7. No length of pipe shall be laid until the proceeding lengths of pipe have been thoroughly embedded in place, to prevent movement or disturbance of the pipe alignment.

8. Full lengths of pipe shall be used in the installation except that partial lengths may be used at the entrance to structures, and to accommodate the required locations of service connection fittings.

9. Pipe entrances to structures shall be cut flush with the inside face of the structure, and cut ends of the pipe surface within the structure shall be properly finished so that there will be no protrusion, ragged edges or imperfections that will impede or affect the hydraulic characteristics of the stormwater flow. The method of cutting and finishing shall be subject to the approval of the Engineer.

10. The Contractor shall protect the installation at all times during construction. The movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Contractor's own risk.

11. Jointing of pipe and fittings shall be done in accordance with the printed recommendations of the manufacturer and as specified. The bell end of the pipe shall be thoroughly cleaned. The joint surfaces and the gasket shall be lubricated prior to making up the joint. The position of the gasket shall be checked to ensure the joint has been properly made and is watertight. Care shall be taken not to exceed the manufacturer's recommended maximum deflection allowed for each joint.

12. Each length of pipe shall be pushed home by hand or with the use of bar and block. The use of power equipment, such as a backhoe bucket, is not acceptable.

13. Field-cut pipe ends shall be cut square.

3.4 INSTALLATION OF DRAIN MANHOLES AND CATCH BASINS

A. The bases shall be supported on a compacted level foundation of gravel borrow a minimum of 12 inches thick. Crushed stone may be substituted for gravel borrow if field conditions at the bottom of the excavation are wet.

1. The Contractor shall install the manholes and catch basins as soon as the pipe laying reaches the location of the structures.

2. The Contractor shall accurately locate each manhole and catch basin and set accurate templates to conform to the required line and grade. Any manhole or catch basin which is not installed in the correct location or oriented improperly shall be removed and rebuilt in its proper location, alignment, and orientation at no additional cost to the Owner.

3. Manhole risers and tops shall be installed using approved butyl rubber sealant or rubber gasket for sealing joints of manhole risers and tops; jointing shall be performed in accordance with the manufacturer's recommendations. Manhole risers and tops shall be installed level and plumb. Water shall not be permitted to rise over newly made joints, nor until after inspection as to their acceptability. All jointing shall be done in a manner to ensure watertight joints.

4. Openings shall be provided in the precast concrete manhole sections to receive entering pipes and these openings shall be made at the place of manufacture. Pipe entrances at catch basins shall have plain beveled openings to accept the type of pipe specified and to be sealed with non-shrink grout. Grout mixture shall follow instructions provided by manufacturer. Pipe connections at drain manholes shall be made as indicated on the Drawings with either non-shrink grout or integral flexible rubber sleeves and Corrugated Pipe Adapters designed for use with the pipe and sleeves. For grouted joints, surface between pipe and wall shall be completely filled with non-shrink grout

and troweled to provide a smooth surface conforming to both the outside and inside structure wall.

5. Care shall be taken to ensure that the openings are made to permit setting of the entering pipe at its correct elevation as indicated or directed. Manhole risers and tops shall be installed so that the manhole steps shall be in alignment.

6. All holes used for handling shall be thoroughly plugged with non-shrink grout.

7. Cutting or tampering in the field, for purpose of creating new sidewall openings or altering existing openings, will not be permitted except at the discretion of the Engineer or if necessary concrete block manhole(s) shall be used.

8. All interior manhole joints where the sealing material is not flush with the inside wall shall be grouted with non-shrink mortar and finished by hand/wet-brush.

9. A cast-in-place concrete invert shelf and channel shall be poured and shaped to the lower half of the pipes

10. Clean all debris, mortar, and soil from the bottom of all structures prior to final acceptance of the project.

3.5 SETTING MANHOLE FRAMES AND COVERS AND CATCH BASIN FRAMES AND GRATES

A. Manhole and catch basin frames shall be set with tops conforming accurately to the grade of the pavement or finished ground surface or as indicated on the Contract Drawings or as directed.

B. Brick shall be used to bring the frames to the required elevation.

1. Frames shall be set centered with the opening in the top of the precast structure on two to four courses of brick in a full bed of mortar. A thick ring of mortar extending to the outer edge of brick or concrete shall be placed all around the bottom flange of the cast iron frame. The mortar shall be smoothly finished to a height of 5 inches above the flange for 8-inch frames and sloped to shed water away from the frame.

2. Completed brick installation shall be coated with mortar at least a ¾ inch thick on the outside to provide a fully sealed and watertight collar between the top manhole section and the cover frame.

3. Only clean bricks shall be used in brick work to adjust frame elevations. The brick shall be moistened by suitable means.

C. Manhole covers shall be left in place in the frame until completion of other work at the manholes.

D. Where directed, the castings shall be temporarily set at such grades as to provide drainage during construction. The castings of structures located within the pavement area shall not be completely set to the established grade until the bottom course of pavement has been laid. The final setting of all other casting shall be performed at the proper stage of construction.

3.6 CHANGE IN TYPE

A. When an existing catch basin is to be converted to a manhole, the frame and grate shall be carefully removed and a new frame and cover installed to finish grade. If in the opinion of the Engineer the existing casting is reusable, it may be reused in the work, otherwise, it shall be disposed of off-site.

1. The sump of the catch basin shall be thoroughly cleaned of debris and silt and the interior surfaces brushed to remove contaminants.

2. The sump shall be thoroughly filled with compacted gravel to a level no greater than 6 inches below the pipe invert. A cast-in-place concrete invert shelf and channel shall be poured and shaped to the lower half of the pipes.

3. New openings in existing structures shall be carefully cut with power saws of the proper size and elevation to accept the new connection. Damage to the structure caused by the Contractor's construction methods shall be repaired at no additional cost.

3.7 INSTALLATION OF WATER QUALITY STRUCTURES

A. Contractor shall take appropriate action to protect all structure components throughout the installation and construction process. Care shall be taken in loading, transporting, and unloading to prevent damage to materials during storage and handling.

B. Install water quality structures per manufacturer's specifications.

C. The installation of a precast concrete structure should conform to ASTM C 891 for the construction of manholes.

D. The precast concrete structure shall be installed in sections in the following sequence:

1. Aggregate Base: Structure shall be supported on a compacted level foundation of gravel borrow or crushed stone a minimum of 12 inches thick.

2. Base Slab

3. Treatment chamber section(s)

4. Transition slab (if required)

5. Bypass Section

6. Connect inlet and outlet pipes

7. Riser section and/or transition slab (if required)

8. Maintenance rider section(s) (if required)

9. Frame and access cover

E. The precast base shall be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, shall be installed in accordance with the precast concrete manufacturer's installation requirements.

F. Adjustment of the stormwater quality treatment structure can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets shall be repaired or replaced as necessary. Once the stormwater quality treatment structure has been constructed, any lift holes shall be plugged watertight with mortar or non-shrink grout.

G. Internal components requiring field installation shall be installed by the Contractor in accordance with the manufacturer's specifications and installation requirements.

H. Inlet and outlet pipes should be securely set into the structure using approved pipe seals (flexible boot connections) so that the structure is watertight.

I. Grade rings shall be installed to set the frame and cover at the required elevation. The grade rings shall be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover shall be set in a full bed of mortar at the elevation specified.

J. If precast tank sections are to be field assembled, adequate waterproofing shall be used at the joint to resist the waterhead at that joint.

K. Couplings which are factory manufactured shall be installed at all connections from existing pipe to proposed pipe unless the existing pipe is the same material as the proposed pipe and the bell and spigot end of the pipes to be connected are compatible and free from defects. All drain couplings shall be installed in accordance with the manufacturer's recommendations for the types of pipe to be connected.

3.8 CLEANOUTS

A. Install cleanouts and extensions from drain pipe to cleanout at grade as indicated on the Contract Drawings. Set cleanout frame and cover in concrete 18 by 18 by 6-inches deep, except where location is in bituminous or concrete paving. Set top of cleanout 1-inch above surrounding earth grade or flush with grade when installed in paving.

3.9 TAP CONNECTIONS

A. Make connections to existing underground drainage structures, so that finished work will conform as nearly as practicable to requirements specified for new work. The contractor shall verify the location, size, invert, and type of existing pipes at all points of connection prior to make the connections.

B. Make branch connections from side into existing piping by installing a wye or T-wyes, and couplings manufactured for use with the same type of pipe as indicated on the Contract Drawings. The Contractor shall install a 45-degree wye branch or 90-degree tee fittings in the drain pipe at all locations where storm service pipe connections are shown on the Drawings. Connections of the storm service pipes shall be made into the wye branches or tees by means of 45-degree bends. The connections shall be made thoroughly watertight and concrete shall be placed under each connection to bear on undisturbed earth and firmly support the connection.

C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

D. Connections into existing drainage facilities shall be performed in accordance with the requirements of the City of Newton. The Contractor shall comply with all such requirements, including securing of all required permits and paying the costs thereof.

3.10 BACKFILLING

A. General: Conduct excavation and backfill operations for structure and pipe installations in accordance with Section 312000 – EARTH MOVING, local requirements, and the contract documents.

B. Initial backfill shall be placed evenly on both sides of the pipe to distribute the load and not to cause movement or deflection of the pipe.

3.11 INSTALLATION OF IDENTIFICATION

A. Install continuous plastic underground warning tape during back-filling of trench for underground storm drainage system piping. Locate tape two-feet below finished grade, directly over piping.

3.12 FIELD TESTING OF CORRUGATED POLYETHYLENE PIPING

A. The pipe shall be cleaned and visually inspected for offsets and obstructions prior to testing.

B. The total length of each pipe installed on the project shall be tested or inspected for deflection. Conveyance pipes connecting at both ends to concrete drainage structures (catch basins, manholes, outlet control structures, water quality structures, etc.) shall be mandrel tested. Deflection of pipes used for stormwater detention/retention/infiltration systems, and pipes connecting to wye connections, building connections, trench drains, and other connections that do not allow mandrel testing shall be verified by visual inspection by the Owner's Representative during installation.

C. Mandrel tests shall be performed by the Contractor and observed by the Owner's Representative not sooner than 20 days after completion of installation and compaction of backfill. Testing for pipes greater than 24-inch in diameter shall be tested prior to the installation of drainage structure cone and frame.

D. Installed pipe shall be tested to ensure that the maximum deflection of the pipe does not exceed 7.5 percent of its base inside diameter. The base inside diameter is defined as the specified nominal diameter minus the allowable inside diameter tolerance of 1.5% but not more than 1/2 inch.

E. A mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. The mandrel diameter shall be verified and approved by the Owner's Representative prior to use. Use of an unapproved mandrel will invalidate the test. If the mandrel fails to pass through the pipe, the pipe will be deemed to be over-deflected.

F. The mandrel shall be a rigid device, with an odd number of legs (9 legs minimum) having an effective length not less than its nominal diameter. The mandrel shall be fabricated of steel with pulling rings at each end.

G. The minimum diameters at any point along the full length are as follows:

Nominal Size	Minimum Mandrel Diameter
6”	5.3”
8”	7.0”
10”	8.8”
12”	10.6”
15”	13.2”
18”	15.8”
24”	21.1”
30”	26.4”
36”	31.7”
42”	37.0”
48”	42.2”
54”	47.5”
60”	52.8”

3.13 FIELD QUALITY CONTROL

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

B. Video Inspections: Seven days after the completion of the backfilling of each section of new pipe, as defined as a length of pipe between two manholes, the Contractor will provide a televised inspection of the pipe to be submitted to the Designer. The Owner’s Representative shall be present during the recording. The recording shall be in DVD color format with audio and will show a clear picture of the inside of the new pipe. If the Designer determines that the DVD is unacceptable for review the contractor shall re-televise the line until an acceptable DVD has been submitted. In the event that the pipe is not acceptable for any reason relating to the proper construction of the pipe according to these specifications, the Contractor will be responsible to re-excavate and repair the defects to the satisfaction of the Designer at no additional cost.

C. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.

2. Place watertight plugs in ends of uncompleted pipe at end of day or whenever work stops. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe eliminated.

3. Flush piping between manholes to remove collected debris.

D. Interior Inspection: If deemed necessary by the Owner’s Representative, inspect piping to determine whether line displacement or other damage has occurred.

1. Make inspections after pipe between manholes has been installed and approximately 2 feet of backfill is in place, and again at completion of project.

2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, the Contractor shall correct such defects and reinspect.

E. Prior to acceptance of the storm drainage system, the Contractor shall submit the following to the Architect and to the local authority:

1. System As-Built Plan stamped by a Professional Land Surveyor or Engineer Registered in the Commonwealth of Massachusetts.

2. Video inspection DVDs and report: The report shall document the observations of the video inspections.

3. Deflection test report: The report shall fully describe the test procedures and list the test results. The report shall be signed by the Contractor's superintendent.

3.14 FINAL INSPECTION

A. Final inspection and acceptance of the storm drainage system shall be made by the Owner's Representative and the utility owner having jurisdiction of the particular system.

B. Prior to placing the systems in service, all components shall be inspected, with the Owner's Representative present, to ensure that no debris or other contaminants are present. If necessary, the Contractor shall clean the structures and flush piping.

C. The Contractor is responsible for coordinating and scheduling the inspection of the work by local jurisdictional authorities. No additional payment will be made for inspections and permits required in the performance of the work.

END OF SECTION

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EMSL Order:	132002448
Customer ID:	UEC63
Customer PO:	
Project ID:	

Attention:	Ammar Dieb	**Phone:**	(617) 984-9772
	Universal Environmental Consultants	**Fax:**	(508) 628-5488
	12 Brewster Road	**Received Date:**	03/26/2020 2:30 PM
	Framingham, MA 01702	**Analysis Date:**	03/27/2020
		Collected Date:	
Project:	687 Watertown Street; Newton, MA		

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
1 *132002448-0001*	Room 213 - Folding Partition	Gray/Tan Fibrous Homogeneous	50% Cellulose	50% Non-fibrous (Other)	None Detected
2 *132002448-0002*	Room 213 - Folding Partition	Gray/Tan Fibrous Homogeneous	50% Cellulose	50% Non-fibrous (Other)	None Detected
3 *132002448-0003*	Room 213 - Glue on Partition	Yellow Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
4 *132002448-0004*	Room 213 - Glue on Partition	Yellow Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
5 *132002448-0005*	Room 213 - Partition Tape	Tan Fibrous Homogeneous	50% Cellulose	50% Non-fibrous (Other)	None Detected
6 *132002448-0006*	Room 213 - Partition Tape	Tan Fibrous Homogeneous	50% Cellulose	50% Non-fibrous (Other)	None Detected
7 *132002448-0007*	Room 213 - Glue on Tape	Yellow Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
8 *132002448-0008*	Room 213 - Glue on Tape	Yellow Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
9 *132002448-0009*	Room 213 - Felt Padding on Partition	Black Fibrous Homogeneous	95% Synthetic	5% Non-fibrous (Other)	None Detected
10 *132002448-0010*	Room 213 - Felt Padding on Partition	Black Fibrous Homogeneous	95% Synthetic	5% Non-fibrous (Other)	None Detected
11 *132002448-0011*	Room 213 Wall Hiding Partition - Joint Compound	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
12 *132002448-0012*	Room 213 Wall Hiding Partition - Joint Compound	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
13 *132002448-0013*	Room 213 Below Partition - Carpet Glue	Yellow Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14 *132002448-0014*	Room 213 Below Partition - Carpet Glue	Yellow Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 03/27/2020 11:51:07

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EMSL Order:	132002448
Customer ID:	UEC63
Customer PO:	
Project ID:	

Analyst(s)
Elizabeth Stutts (14)

Steve Grise, Laboratory Manager
or Other Approved Signatory

Initial report from: 03/27/2020 11:51:07

OrderID: 132002448

132002448

CHAIN OF CUSTODY

Universal Environmental Consultants
12 Brewster Road
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adieb@uec-env.com

PLM
24-hour TAT

Town/City: Newton, MA Building Name 687 Watertown Street

Sample	Result	Description of Material	Sample Location
1		Folding Partition	Room 213
2		" "	" "
3		Glue on Partition	" "
4		" "	" "
5		Partition Tape	Room 213
6		" "	" "
7		Glue on tape	" "
8		" "	" "
9		Felt Padding on Partition	Room 213
10		" "	" "
11		Joint compound	Room 213 wall hiding partition
12		" "	" "
13		Carpet glue	Room 213 below partition
14		" "	" "

REC'D 14:30 EST MAR 26 2020

Reported By: Jason Berube Date: 3-26-20 Due Date: ----------

Received By: ---------- Date: ----------

UNIVERSAL ENVIRONMENTAL CONSULTANTS

CITY OF NEWTON, MASSACHUSETTS

PUBLIC BUILDINGS DEPARTMENT

52 ELLIOT STREET, NEWTON HIGHLANDS, MA 02461

Ruthanne Fuller, Mayor
Josh Morse
Building Commissioner

Telephone (617) 796-1600
Facsimile (617) 796-1601
TDD/tty # (617) 796-1608

June 17, 2021

Nick Read, Chief Procurement Officer
Newton City Hall
1000 Commonwealth Avenue
Newton Centre, MA 02459

RE: Proprietary Items for the NECP School Project

Dear Nick:

As you are aware, State law for public bid construction projects requires specifications to allow three (3) equal manufacturers for all products unless the Owner approves proprietary specifications.

Specifically, specifications must contain

> **either a minimum of three named brands of material or a description of material which can be met by a minimum of three manufacturers or producers**
>
> **AND**
>
> **for the equal of any one of said name or described materials.**

M.G.L. c. 30, §39M(b).

If the City decides to use the brand name, it must document its decision, certifying the decision was made based on "sound reasons in the public interest." M.G.L. c. 30, § 39M(b). The decision must be based on a "reasonable investigation," and the City must certify the

> **reasons for using the restrictive or proprietary specifications and provide this documentation to anyone making a written request for this information. If you use restrictive or proprietary specifications for an item, the specifications for that item must include an "or equal" clause, which is a provision allowing bidders to furnish items that are equal to the specified item.**

Inspector General*, Designing and Constructing Public Facilities* (9th ed.)(11/16), pp. 37-38.

If the city elects to use a proprietary specification, it must award to the lowest responsible bidder.

For an item to be considered "equal,"

> **(1)it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the public work being contracted for or the material being purchased, and**

(3) it conforms substantially, even with deviations, to the detailed requirements for the item in the said specifications.

M.G.L. c. 30, §39M(b).

In addition, the AG has interpreted the timing of the determination to be after the bids are opened. *See* Bid Decision *In re Town of Walpole* (4/26/18).

Thus, a vendor need not provide its proposed equal with its bid, and the three part determination is to be made if the vendor has submitted the lowest bid and has been awarded the contract. The three-part determination takes place *after* the award of the contract; the City may not award a contract based on the product that the bidder proposes to use.

In preparing IFB #_____ for the construction of the Newton Early Childhood Program (NECP) the City is electing to use certain brand name materials, as follows:

1. **Hardware, 'L' Series Locksets by Sargent**
2. **Hardware, Cylinders by Best**
3. **Hardware, Door Closers by LCN**
4. **Hardware, Door Exist Devices by Von-Duprin**
5. **Electrical, Fire Alarm Panel Notifier by Honeywell**
6. **Access Control by Lenel**
7. **Security Alarm Panel & Equipment by Bosch Radionics**
8. **Building Automation Systems by Delta Controls**
9. **CCTV Systems by Avigilon or compatible manufacturer**

These materials have been selected for existing school systems in order to achieve citywide consistency in maintenance and operations as well as for accessibility to parts and vendors. In order to allow for uniformity and to promote resulting public safety, the Public Buildings Department, Newton Public Schools, and the Fire Department recommend that the nine listed materials be described by brand name.

The City acknowledges the statutory requirement that it must accept an alternative product that is deemed "equal," as that term is defined in M.G.L. c. 30, §39M(b).

Please include appropriate language in the IFB consistent with the foregoing.

Thank you,

Joshua R Morse
Public Buildings Commissioner
City of Newton
Newton Public Buildings Department
52 Elliot Street
Newton Highlands, MA 02461

Release Abatement Measure Completion Report

for the Site:

Horace Mann School
687 Watertown Street
Newton, MA

DEP RTN 3-16552

prepared for:

Department of Public Buildings
City of Newton
52 Elliot Street
Newton, MA 02461

———

prepared by:

Ralph J. Tella, CHMM, LSP
President

Oliver Leek
Senior Project Manager

Lord Associates, Inc.
1506 Providence Highway, Suite 30
Norwood, MA 02062

Job # 1019

February 25, 2020

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1.0 Introduction

1.1 Purpose

Pursuant to 310 CMR 40.0446 of the Massachusetts Contingency Plan (MCP), Lord Environmental, Inc. (LEI) is submitting this Release Abatement Measure (RAM) Completion Report for the Site located at 687 Watertown Street in Newton, Massachusetts. This report has been prepared on behalf of the Responsible Party (RP), the City of Newton Department of Public Buildings and should be applied to Release Tracking Number (RTN) 3-16552. This RTN refers to a release of No. 2 heating oil from former underground storage tanks at the Site. A Site Locus is provided as **Figure 1**.

The RAM was proposed to address residual No. 2 fuel oil underneath the driveway of the Site and immediately surrounding areas. LEI directed the excavation of impacted soil that was acting as source material for the occasional presence of NAPL in select groundwater monitoring wells. The three distinct areas excavated surrounded B-26, B-38, and B-35R. A Site Plan depicting the RAM excavation areas is provided as **Figure 2.**

1.2 Contact Information

Pursuant to 310 CMR 40.0444(1)(a), the following information pertinent to the person assuming responsibility for conducting the RAM (i.e., the Potentially Responsible Party, PRP) is provided as follows:

PRP Contact Information:

Name:	Arthur F. Cabral City of Newton Department of Public Buildings
Address:	52 Elliot Street, Newton, Massachusetts
Telephone:	(617) 796-1602
Relationship:	Budget & Project Specialist

Licensed Site Professional Information:

Name:	Ralph J. Tella, Lord Associates, Inc.
LSP#:	7473
Address:	1506 Providence Highway, Suite 30, Norwood, MA 02062
Telephone:	(781) 255-5554 x14

2.0 Site Description

2.1 Release Description & History

A Notice of Responsibility was sent to the Potentially Responsible Party (PRP), City of Newton, by the Massachusetts Department of Environmental Protection (MADEP) on March 5, 1998. The notice was sent in response to the discovery of an oil sheen on Cheesecake Brook, adjacent to the Horace Mann School. The sheen was attributed to a release of heating oil at the Site, reportedly via severely corroded fuel transfer lines.

A Phase I Initial Site Investigation Report including a Tier Classification Opinion, was prepared by Camp, Dresser & McKee, Inc. (CDM) and submitted to the MADEP on February 26, 1999. The site has been classified as Tier II.

A combined Phase II Comprehensive Site Assessment Report and Phase III Remedial Action Plan were submitted to the MADEP by LAI on March 2, 2001. An Immediate Response Action (IRA) Completion Report was submitted to the MADEP by LAI on January 7, 2002.

On May 27, 2003, a Phase IV Remedy Implementation Plan (RIP) was submitted to the MADEP that proposed the implementation of a groundwater removal and enhancement (GWRE) system as a means of conducting remediation activities at the Site. Installation of the recovery wells and trenching was completed in April 2003. Delivery of the remedial system trailer and installation of the system components and remedial piping was completed between August and September 2003.

On March 5, 2004, a Phase IV RIP Addendum was submitted to the MADEP that proposed the additional implementation of in-situ bioremediation via direct treatment applications in order to address residual fuel oil impacts beneath the foundation of the school. On April 15, 2004, a Phase IV Completion Report was submitted to the MADEP, which documented the design and start-up of the GWRE system.

In May 2004, installation of the system was completed, and the system was activated for continuous operation. Recovery wells RW-3 and RW-4 were utilized for recovery.

Additionally, a second GWRE system was installed in the school basement to address impacts in the vicinity of wells RW-1, B-40/RW, and P-6/MW. This system was started in August 2005. The basement system typically runs at night and the outside (trailer) system runs during the day.

Site specific information such as physical setting, surrounding land use, natural resources, applicable soil & groundwater categories, soil characterization, and groundwater characterization have been presented in previous reports prepared by Lord Associates, Inc. (LAI) and is reiterated herein as appropriate. Analytical data associated with the most recent round of groundwater sampling is included in **Table 2**.

LAI has submitted Phase V Remedy Operation Status Reports for the Site since April 10, 2007 that outlined pertinent information for their respective reporting periods.

LAI prepared a Release Abatement Measure (RAM) Plan for the Site in June 2010, outlining the injection of nutrients into the subsurface at the Site using injection wells. LAI injected a biomix under the concrete slab in the basement at the Site in June 2010.

On January 24, 2011, LAI submitted a combined RAM Completion & REMOPS Report for the Site.

A RAM Plan was submitted to DEP dated April 4, 2019 which outlined the use of vacuum extraction technology to remove total fluids (groundwater and NAPL) from B-26 and B-38 at the Site. Two vacuum extraction events were undertaken under this RAM. A RAM Completion Report was filed with DEP on May 9, 2019.

The Site is currently in Remedy Operation Status (REMOPS) and REMOPS Reports are submitted to DEP twice annually.

2.2 Site Conditions

A significant portion of the petroleum previously released at the Site has been captured by the GWRE systems. However, residual non-aqueous phase-liquid (NAPL) has remained intermittently observed in three groundwater monitoring wells (LB-26/MW, LB-38/MW, and B-35R) at the Site. The majority of groundwater collected at the Site currently meets applicable Method 1 standards, where NAPL is not present. Soil impacts are generally below applicable Method 1 S-1 GW-2/3 standards.

2.3 Surrounding Receptors

Because contaminated soil is located underneath a paved driveway, landscaped areas, and beneath the boiler room and basement floor, soil contaminants are not readily accessible. During the school year, the Horace Mann School generally employs approximately 30 adults, and provides instruction for approximately 350 grammar school students. Currently, the school is vacant pending remodeling. Land use in the vicinity of the site is a mix of residential, recreational, and commercial uses. Albemarle Park, bordering the

site to the north, is comprised of a playground, playing fields, and a swimming pool. To the west, Cheesecake Brook flows in a northerly direction within a channel dividing either side of Albemarle Road. Residential housing lines Albemarle Road directly across Cheesecake Brook. Watertown Street borders the school to the south. Residential and commercial buildings are located along Watertown Street. The Boys and Girls Club facility borders the site to the east.

Cheesecake Brook borders the western edge of the site. No excavation activities were performed within 100 feet of Cheesecake Brook. There are no other surface water bodies within 500 feet of the site. The park immediately to the north of the School property is listed on the DEP Phase 1 Map as Protected Open Space. The estimated residential population within a ½-mile radius is 7,500. There are no institutions (i.e. any publicly or privately owned hospital, health care facility, orphanage, nursing home, convalescent home, educational facility, or correctional facility, where such facility in whole or in part provides overnight housing) within 500 feet of the property.

In the absence of any activities that involve soil and/or groundwater removal, there are no complete exposure pathways at this Site in connection with either human or environmental receptors.

2.4 Natural Resources

Cheesecake Brook borders the western edge of the site, across Albermarle Road. There are no other surface water bodies within 500 feet of the site. The park immediately to the north of the School property is listed on the DEP Phase 1 Map as Protected Open Space.

3.0 Site Conditions

On December 29 and 30, 2009, LAI directed Technical Drilling Services (TDS) of Sterling, Massachusetts in the advancement of eight injection wells at the Site (designated IW-2, IW-3, IW-5, IW-6, IW-7, IW-8, IW-9, and IW-11). These wells are all located inside the basement of the Site with the exception of IW-11, which is located in the Site driveway. These wells were installed in order to facilitate future nutrient injections at the Site and to collect soil data to evaluate current Site conditions. Prior to drilling the basement wells with a portable direct-push rig, the cement floor was cored. **See Figure 2, Site Plan** for a depiction of injection well locations and pertinent Site features. See the March 2010 REMOPS Report for the boring logs for these injection wells and well completion details.

LAI directed New England Geotech of Jamestown, Rhode Island in the installation of four borings in the vicinity if the Site driveway (off Albermale Road) and in the playground adjacent to the school on August 18, 2014. These borings were advanced in order to verify disposal site boundaries, where former wells are not able to be located, and one well was a replacement to a destroyed well. LAI directed the installation of B-37/MW (to replace B-37), and LB-51/MW through LB-53/MW. Soil samples were collected from the borings at five foot intervals in acetate sleeves with a track-mounted direct push rig. Select soil samples were sent to a State-certified laboratory for EPH analysis.

To further delineate the residual NAPL plume in the Site driveway (immediate vicinity of B-26), LAI directed TDS in the advancement of several soil borings with a direct push rig on December 30, 2018. These borings were designated LB-55 through LB-61, and B-35R/MW as a replacement well for B-35 which could not be located. LB-55/MW (in the playground) and B-35R/MW were completed as a two-inch PVC groundwater monitoring wells. These borings were advanced to try to delineate the NAPL plume in the driveway area of the Site prior to proposed excavation activities to coincide with some proposed Site re-development. Boring Logs with the details of the boring advancement and groundwater monitoring well installation are included in **Appendix B**. Fuel oil impacts were observed in the vadose zone to a maximum depth of 14 feet in the immediate vicinity of B-26 and B-38 at the Site.

To further assess groundwater and NAPL conditions in the immediate vicinity of B-26, LAI directed New England Geotech in the advancement of several soil borings on April 16, 2019. These borings were designated LB-61 to LB-65 and all but LB-65 were completed as two-inch PVC groundwater monitoring wells. Boring Logs with the details of the boring advancement and groundwater monitoring well installation are included in **Appendix B**. Fuel oil impacts were observed in the vadose zone to a maximum depth of 14 feet in the immediate vicinity of B-26 and B-38 at the Site. Possible NAPL was observed in a fill gravel layer in select boring locations from approximately 13 to 14 feet bsg. This gravel was used as backfill after the initial UST removal and subsequent excavation of impacted soil when the release was discovered in 1998.

After soil excavation in January 2020, LEI directed the re-installation of B-26, B-38, and B-35 with a direct push rig operated by New England Geotech on February 14, 2020. LEI also directed the re-installation of B-19 that had previously been destroyed, and advanced Borings LB-70 and LB-71 in the northeastern portions of the property to verify the extent of contamination. Soil samples were collected continuously and were logged and field-screened with a PID. Select soil samples were placed in laboratory-provided glassware for analysis of EPH. Boring Logs and laboratory certificates of analysis for these samples will be provided in the upcoming ROS Report for the Site.

3.1 Soil Sampling & Field Screening

Continuous soil samples were collected using disposable acetate sleeves. Soil samples were characterized and field–screened with a Thermo Environmental Instruments (Thermo) photo-ionization detector (PID) for total organic vapors (TOV). LAI sent selected soil samples, collected at the approximate groundwater table to state-certified laboratories for analysis of extractable petroleum hydrocarbons (EPH) via DEP methodology.

3.1.1 Laboratory Analytical Data - Soil

Laboratory analytical data for soil samples collected during the advancement of the injection wells in 2009 and the replacement wells in 2014 indicated EPH carbon fraction ranges and/or EPH target analytes in each sample above laboratory method detection limits. However, all EPH detections were below applicable Method 1 S-1 GW-2/3 standards. Based on physical observations and field-screening that indicated soil conditions consistent with previous assessments, no soil samples collected in December 2018 and April 2019 were sent for laboratory analysis with the exception of a soil sample sent to the lab for disposal characterization. See **Table 11** for a summary of soil analytical data with comparisons to applicable standards.

3.2 Groundwater Monitoring Activities

In the last six months, LAI visited the Site and gauged wells including P-1B, P-5BR, P-6BR, P-8B, B-2, B-18/MW, B-20/MW, B-22/MW, B-26/MW, B-31/MW, B-35R/MW (replacement of B-35/MW), B-37R/MW (replacement of B-37/MW), B-38/MW, IW-2, IW-3, IW-5, IW-6R (replacement of IW-6), IW-7, IW-8, LB-51/MW, LB-53/MW, LB-54/MW, LB-55/MW, LB-61/MW, LB-62/MW, LB-63/MW, and LB-64/MW.

NAPL was not observed in any wells during this reporting period with the exception of B-26/MW and B-38/MW. A maximum of 0.90 feet of NAPL was measured in B-26/MW in March 2019, a maximum of 0.04 feet of NAPL was measured during this reporting period in B-38/MW in August 2019, and a maximum of 0.20 feet of NAPL was measured in B-35R/MW in April 2019. Petroleum-absorbing socks were placed in B-26/MW , B-35R/MW, and B-38/MW to absorb the NAPL present and were checked on subsequent Site visits. NAPL was recovered from Site wells B-26/MW, B-35R, and B-38/MW with absorbent socks during this reporting period. Spent absorbent socks are placed into the 55-gallon drum containing oil and spent absorbents that is located in the Site building

basement pending accumulation and eventual disposal. Refer to **Table 1** for a summary of groundwater gauging data.

Groundwater samples were last collected on August 6, 2019 , LAI collected groundwater samples from the following wells: B-18/MW, B-20/MW, B-22/MW, P-1B/MW, P-6BR/MW, IW-3/MW, IW-6R/MW, B-35R, LB-51/MW, LB-53/MW, LB-54/MW, and LB-55/MW. B-26/MW and B-38/MW were not sampled for analysis due to observations of a sheen.

At least three well volumes were purged from each well prior to sampling groundwater. Samples were collected with a peristaltic pump and disposable polyethylene tubing and placed in laboratory-provided sample jars. The samples were collected using HCl-preserved 950 mL amber glass EPH bottles. Samples were stored at four degrees Celsius until being couriered to Alpha Analytical, Inc. (Alpha) of Westborough, Massachusetts for EPH analysis.

3.2.1 Laboratory Analytical Data - Groundwater

Based on laboratory analytical data for groundwater samples collected in August 2019, petroleum contaminants in groundwater from all wells sampled during these rounds are below applicable GW-2/3 groundwater standards. Additionally, groundwater collected from B-35R, which had 0.20 feet of NAPL as measured in April 2019, did not have concentrations of EPH above laboratory method detection limits. Groundwater collected from wells B-20, IW-3, LB-53/MW, and LB-55/MW did not have any EPH concentrations above laboratory method detection limits. Refer to **Table 2,** for a summary of EPH carbon fraction laboratory analytical data and to **Figure 2** for recovery and monitoring well locations.

3.3 Vapor Point Installation & Sampling

On January 15, 2013, LAI installed twelve vapor points (designated VP-1 through VP-12) in the concrete floor of the Site basement. Holes for the vapor points were drilled through the approximately 6-inch this concrete using a hammer drill. After the holes were drilled, a vapor point housing was inserted into the hole making an air-tight seal. These housings allow for sampling of vapor points and can be closed after sampling.

On March 26, 2013, LAI personnel field-screened soil vapor in all of the recently-installed vapor points (VP-1 through VP-12). Prior to screening, all of the vapor points were developed/purged using a peristaltic pump. Vapor points were purged for approximately 5 minutes prior to field-screening. The vapor points were field screened with a Thermo Environmental Instruments Model 580B Photo-ionization detector (PID) for total organic vapor (TOV). TOV values ranged from 0.5 parts per million by volume

(ppmv) in VP-9 to over 1,000 ppmv in VP-2. Results of this screening are summarized in **Table 7**. It is unclear why vapor from VP-2 had such a response on the PID, as no odors were apparent.

On April 18, 2013, LAI personnel collected soil vapor samples using Summa canisters. Each vapor point was purged with a peristaltic pump for 2 minutes prior to sample collection. Samples were collected as "grab" samples and were submitted to Alpha under chain-of-custody documentation for the analysis of Air phase hydrocarbons (APH).

Laboratory analytical results indicate the presence of C_9-C_{12} Aliphatics above laboratory method detection limits in soil vapor collected from all four sampling locations. Additionally, C_5-C_8 Aliphatics were present above laboratory method detection limits in soil vapor collected from VP-2 and VP-6. No APH target analytes were detected above laboratory method detection limits. All APH carbon fraction detections were below DEP soil vapor Residential and Commercial Threshold Values, indicating that a vapor intrusion pathway is not likely. Copies of the original laboratory certificates of analysis and chain-of-custody documentation are attached in **Appendix B**.

3.4 Indoor Air APH Sampling

On April 17, 2013, LAI personnel collected indoor air samples from three locations in the lower level of the School. These locations were in the Gym, the Lunch Prep Room, and the Assembly Room. Samples were collected using Summa Canisters placed in the approximate center of these areas approximately three-to-four feet above the ground (in the breathing zone). These samples were collected as 24-hour composite samples.

Laboratory analysis indicates the presence of toluene and C_5-C_8 Aliphatics above laboratory method detection limits in all three samples. Additionally, C_9-C_{12} Aliphatics were present above laboratory method detection limits in the air samples collected from the Gym and the Assembly Room. The detection of C_5-C_8 Aliphatics (at 80 µg/m^3) is above the Residential Threshold Values but below the Commercial/Industrial Threshold Values. Based on the exceedance of a residential Threshold Value, LAI completed Method 3 Shortforms in order to determine risk. Two Shortforms were used: sf12osaih in order to evaluate the Imminent Hazard Risk to Office workers, students, and teachers, and sf12osa in order to evaluate the long-term risk to Office workers, students, and teachers. The highest concentrations of toluene (7.2 µg/m^3), C_5-C_8 Aliphatics (80 µg/m^3), and C_9-C_{12} Aliphatics (23 µg/m^3) were entered into the Shortforms. The Shortform calculations indicate that there is no excess lifetime cancer risk (ELCR) and the Hazard Index is less than 1. Therefore, there is "No Significant Risk" related to these indoor air concentrations of APH constituents. Copies of the Shortforms have been included in previous submissions.

On December 28, 2016, LAI personnel collected indoor air samples from three locations in the lower level of the School. These locations were in the Gym, the Lunch Prep Room, and the Assembly Room. Samples were collected using Summa Canisters placed in the approximate center of these areas approximately three-to-four feet above the ground (in the breathing zone). These samples were collected as 24-hour composite samples.

Laboratory analysis indicates the presence of toluene above laboratory method detection limits in all three samples. Additionally, C_9-C_{12} Aliphatics were present above laboratory method detection limits in the air samples collected from the Assembly Room and naphthalene was detected above laboratory method detection limits in the air sample collected in the lunch prep room. However, these concentrations are all well below the DEP published Residential and Commercial/Industrial Threshold Values.

4.0 RAM Activities

4.1 Excavation of Residually-Impacted Soil

As NAPL has been observed periodically in groundwater monitoring wells B-26, B-38, and B-35R that precluded Site closure, excavation of the areas surrounding these wells was undertaken under this RAM. Based on assessment activities at the Site over the course of the cleanup since 1998, impacted soil has been observed to be present from approximately 9 feet bsg to approximately 14 feet bsg in the vicinity of the driveway at the Site. Groundwater generally ranges from 9-10 feet bsg in this vicinity of the Site.

On January 14, 2020, Petroleum Management Services, Inc. (PMS) of Wakefield, Massachusetts removed clean overburden soil with a track-mounted excavator from the B-38 area to a depth of approximately 9 feet bsg. This soil was stockpiled in the northeast portion of the Site on the asphalt-paved surface pending re-use as backfill. This soil was segregated based on visual observations, historic boring data, and PID screening. On January 15, 2020, PMS excavated impacted soil from the B-35 area with a track-mounted excavator and loaded it into a dump truck for transport to the stockpile area in the northeastern part of the property on the asphalt-paved parking area. Stockpiled impacted soil was be placed on 6-mil polyethylene (poly) sheeting and was covered in 6-mil poly sheeting at the end of each workday. The stockpile area was surrounded with hay bales, with the base layer of poly extending over the top of the hay bales so that free liquids, if present, would stay in the stockpile area and could be managed appropriately. Approximately 20-25 cubic yards (cy) of impacted soil was removed to a maximum depth of approximately 15 feet bsg. Groundwater was encountered at approximately 10

feet bsg, and therefore dewatering was necessary. The following section describes the dewatering details. The area of the open excavation was approximately 20 feet by 20 feet. Excavation was terminated when the excavation sidewalls kept collapsing due to depth and the presence of groundwater. As such, no confirmatory soil samples were collected.

Excavation of the B-35 area started on January 17, 2020 with the excavation and stockpiling of clean overburden soil to an approximate depth of 9 feet bsg. This soil was determined to be free from residual fuel oil impacts based on visual observations, previous boring data, and PID screening. This soil was transported by dump truck to the clean stockpile area in the northeast portion of the Site. On January 20, 2020, LEI directed PMS in the excavation and stockpiling of the residually impacted soil in conjunction with dewatering activities. Soil was excavated to a maximum depth of approximately 15 feet bsg when excavation was terminated as sidewalls kept collapsing due to depth and the presence of groundwater. Excavated impacted soil was loaded into a dump truck and transported to the on-Site stockpile area and placed on 6-mil poly sheeting. The area of the excavation was approximately 20 by 25 feet and approximately 30-40 cy of impacted soil was excavated from the B-38 area prior to backfilling. Confirmatory soil samples were not collected due to the unstable nature of the excavation and the presence of significant groundwater.

On January 27, 2020, PMS removed clean overburden soil with a track-mounted excavator from the B-26 area to a depth of approximately 9 feet bsg. This soil was stockpiled in the northeast portion of the Site on the asphalt-paved surface pending re-use as backfill. This soil was segregated based on visual observations, historic boring data, and PID screening. Due to the proximity of a storm drain line and a concrete sidewalk, an 8-foot wide trench box was placed into the excavation to facilitate the removal of impacted soil at depth. Additionally, 4-foot long steel road plates were driven along-side the trench box. On January 28, 2020, PMS excavated impacted soil from the B-35 area with a track-mounted excavator and loaded it into a dump truck for transport to the stockpile area in the northeastern part of the property on the asphalt-paved parking area. Stockpiled impacted soil was be placed on 6-mil polyethylene (poly) sheeting and was covered in 6-mil poly sheeting at the end of each workday. The stockpile area was surrounded with hay bales, with the base layer of poly extending over the top of the hay bales so that free liquids, if present, would stay in the stockpile area and could be managed appropriately. Approximately 20-25 cubic yards (cy) of impacted soil was removed to a maximum depth of approximately 15 feet bsg. Groundwater was encountered at approximately 10 feet bsg, and therefore dewatering was necessary. The following section describes the dewatering details. The area of the open excavation was approximately 10 feet by 25 feet. Excavation was terminated when the excavation

sidewalls kept collapsing due to depth and the presence of groundwater. As such, no confirmatory soil samples were collected.

Impacted soil was loaded into trailer dump trucks operated by Clean Earth and transported to Clean Earth (formerly ESMI of NH) in Loudon, New Hampshire on January 16 (34.53 tons), January 22 (64.11 tons), and January 31, 2020 (29.58 tons). This soil was transported under a Bill of Lading. A total of 150.41 tons of soil were excavated and transported to Clean Earth. The Attested Bill of Lading will be provided once the Attestation is complete.

4.2 Dewatering

As groundwater was present in the RAM area at depths generally ranging from 9-10 feet bsg, dewatering was necessary to facilitate the excavation of impacted soil down to approximately 14-15 feet. A two-inch pump was used to facilitate the draw-down of local groundwater and NAPL, where present. This water was pumped into a 20,000-gallon fractionation tank (frac tank) located to the east of the excavation areas during each of the three excavations. NAPL was observed in all three of the excavations and a heavy sheen and some oil globules were observed in water contained in the frac tank. A total of approximately 9,630 gallons were pumped into the frac tank. On February 6, 2020, approximately 8,300 gallons was pumped from the frac tank into a tanker operated by Global Remediation Services of Taunton, Massachusetts for transportation under manifest to Global Cycle in Taunton, Massachusetts for recycling. The remaining 1,330 gallons in the frac tank consisted of water and silt. This material was removed from the frac tank with a vactor truck and was transported under manifest to Tradebe Treatment and Recycling in Stoughton, Massachusetts for disposal/recycling. See **Appendix B** for copies of the Uniform Hazardous Waste Manifests.

5.0 Environmental Monitoring

Subsequent to RAM activities, LEI will collect data for the presence of NAPL in Site wells. LAI will continue to monitor for the accumulation of NAPL, if any, after excavation in Site wells and will remove NAPL as necessary. Any recovered NAPL will be stored in the 55-gallon drum in the basement of the Site that is used to store accumulating recovered NAPL.

On behalf of the City of Newton, LAI plans to pursue a Permanent Solution for the Site pursuant to current DEP LNAPL Final Policy #WSC-16-450, dated February 2016, when NAPL levels in Site wells are appropriate.

6.0 Public Involvement

6.1 Notification to CMO & BOH

As required by 310 CMR 40.1403(3)d, LAI provided letters to both the Chief Municipal Officer (CMO) and Board of Health (BOH) in the City of Newton regarding the purpose, nature, and expected duration of RAM activities.

6.2 Public Involvement Plan

A copy of this RAM Completion Report is being submitted to interested parties including the Newton Public Library in accordance with the Final Public Involvement Plan dated February 9, 2018.

FIGURES

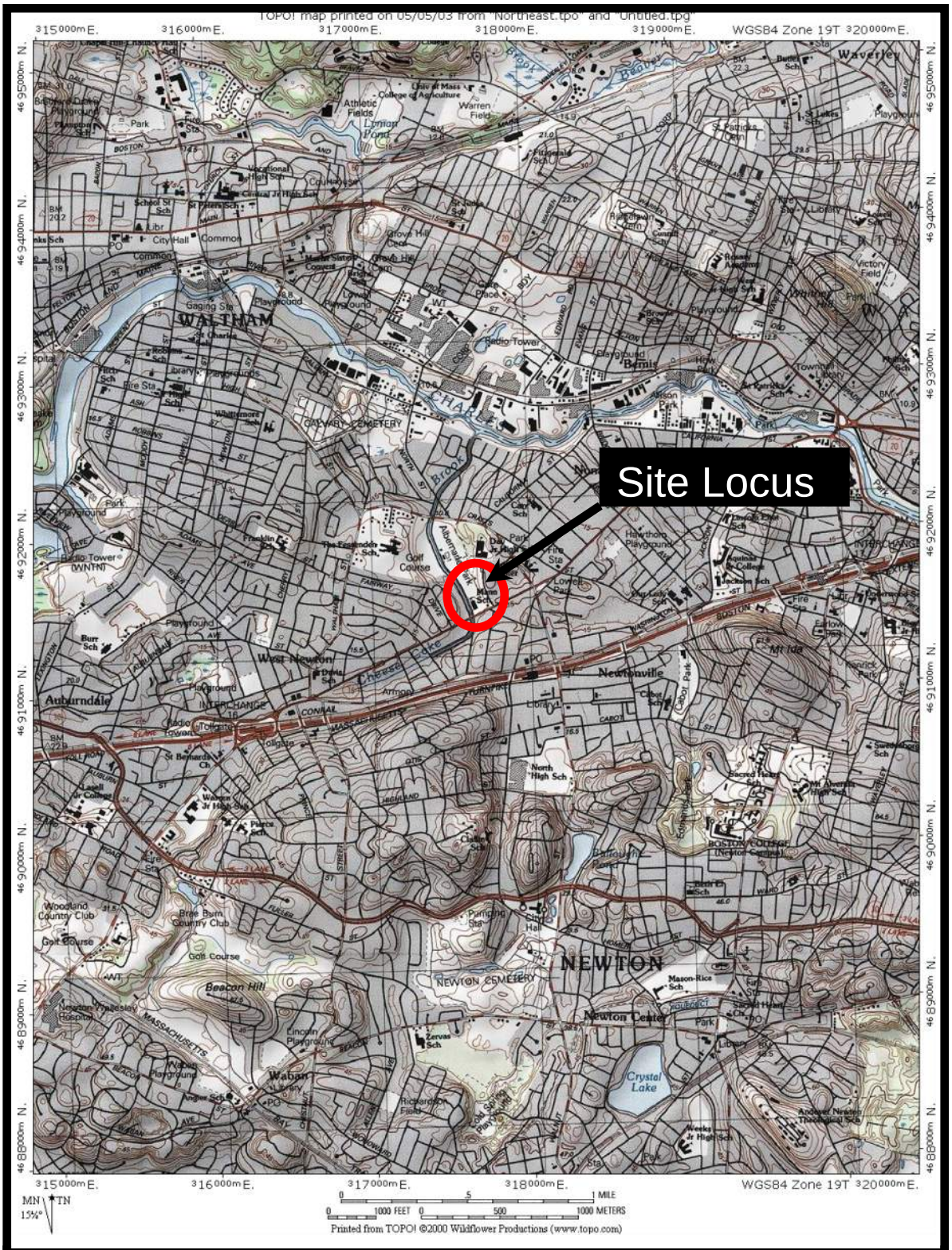

Figure 1. Site Locus
Horace Mann School
687 Watertown Street
Newton MA

prepared by:
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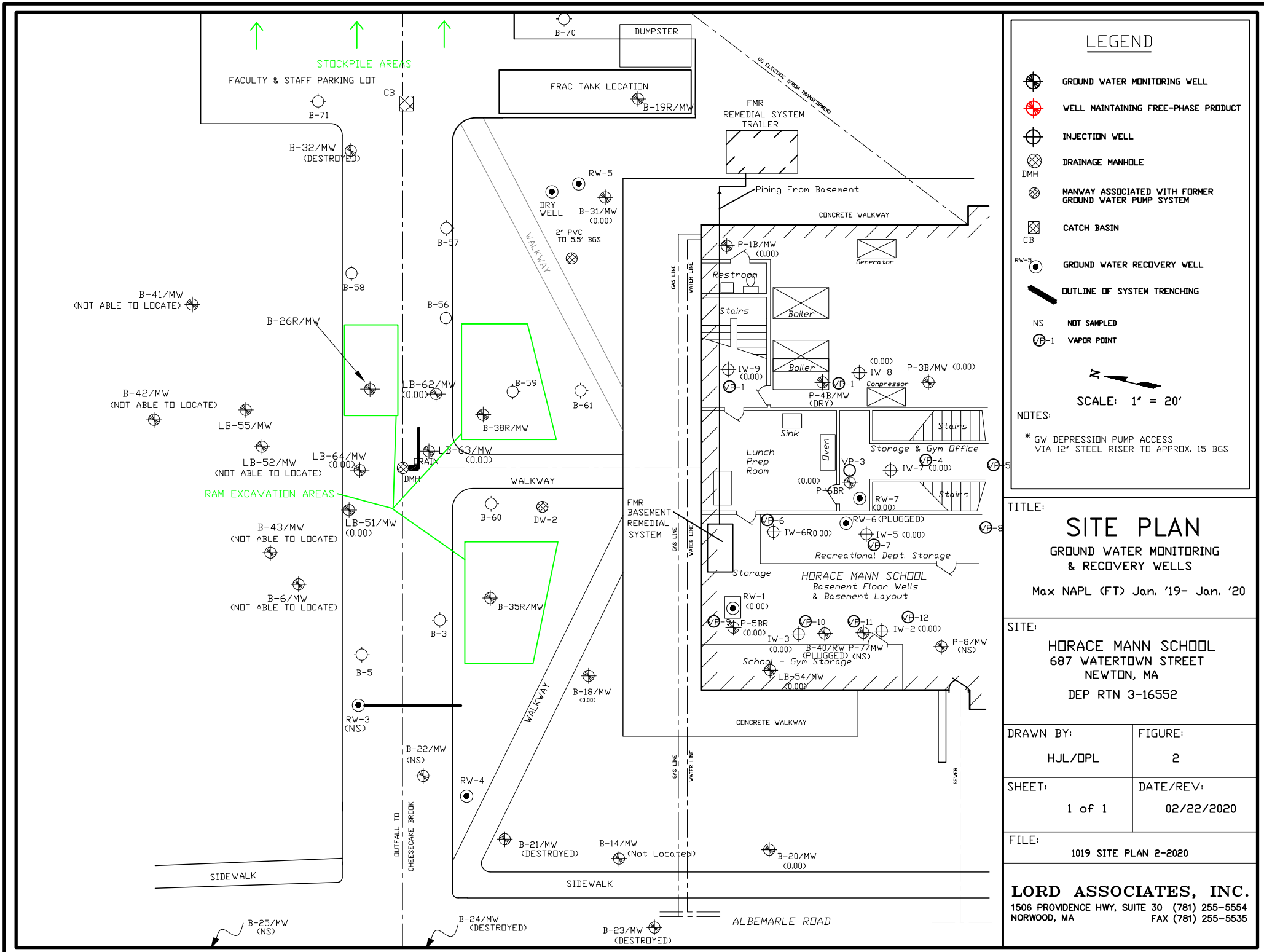


LEGEND

- GROUND WATER MONITORING WELL
- WELL MAINTAINING FREE-PHASE PRODUCT
- INJECTION WELL
- DMH — DRAINAGE MANHOLE
- MANWAY ASSOCIATED WITH FORMER GROUND WATER PUMP SYSTEM
- CB — CATCH BASIN
- RW-5 — GROUND WATER RECOVERY WELL
- OUTLINE OF SYSTEM TRENCHING
- NS — NOT SAMPLED
- VP-1 — VAPOR POINT

N

SCALE: 1" = 20'

NOTES:

* GW DEPRESSION PUMP ACCESS VIA 12" STEEL RISER TO APPROX. 15 BGS

TITLE:

SITE PLAN

GROUND WATER MONITORING & RECOVERY WELLS

Max NAPL (FT) Jan. '19- Jan. '20

SITE:

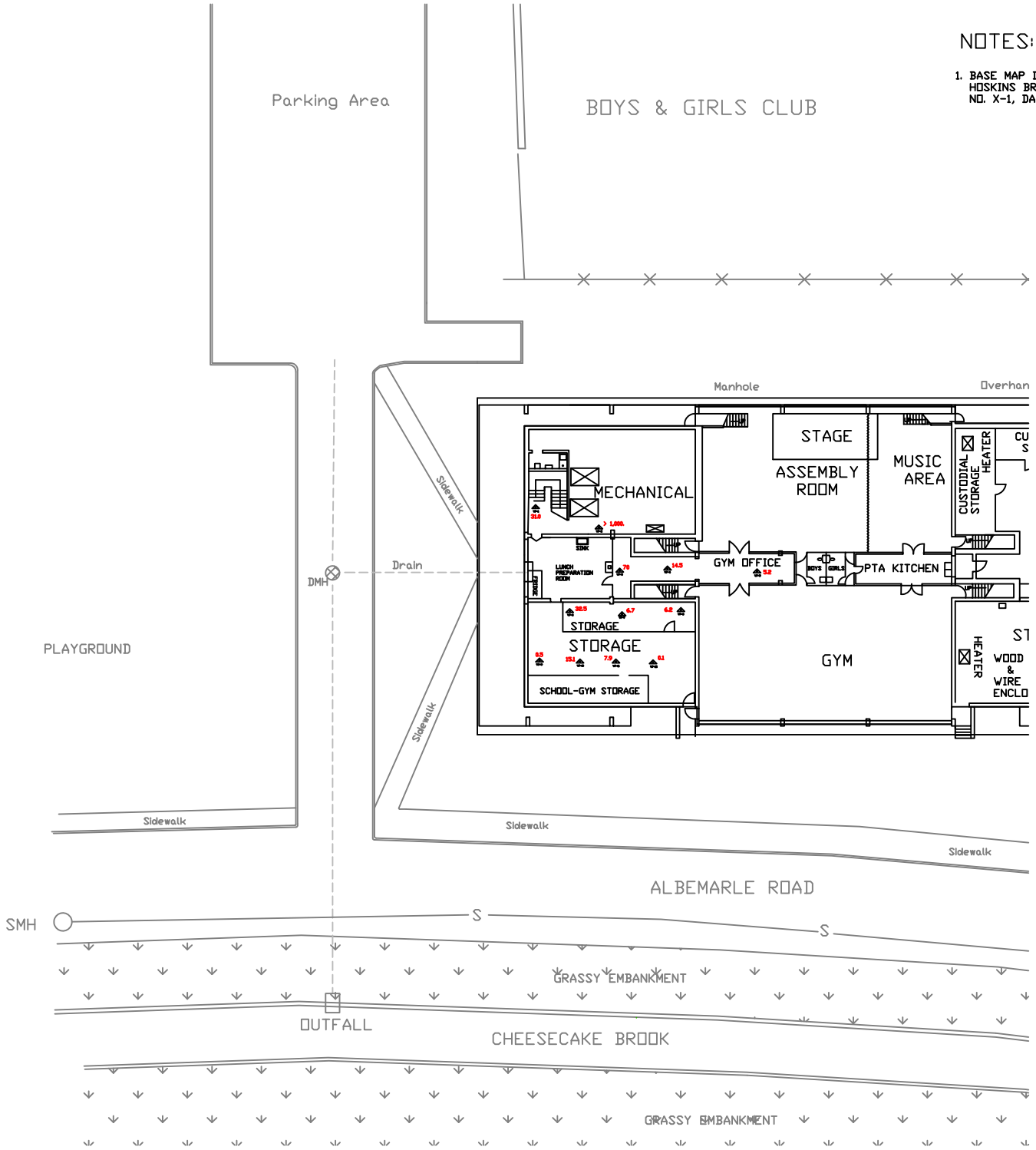
HORACE MANN SCHOOL
687 WATERTOWN STREET
NEWTON, MA

DEP RTN 3-16552

DRAWN BY:	FIGURE:
HJL/OPL	2
SHEET:	DATE/REV:
1 of 1	02/22/2020

FILE: 1019 SITE PLAN 2-2020

LORD ASSOCIATES, INC.
1506 PROVIDENCE HWY, SUITE 30 (781) 255-5554
NORWOOD, MA FAX (781) 255-5535



NOTES:

1. BASE MAP DEVELOPED FROM 'SITE & LANDSCAPING PLAN' BY WILLIAM HOSKINS BROWN ASSOCIATES, INC., ARCHITECTS, BOSTON, MA., DRAWING NO. X-1, DATED OCT. 1963.

LEGEND

SMH SEWER MANHOLE

DMH DRAIN MANHOLE

S SEWER LINE

FENCE

7.9 Vapor Point and result

VP-11

SCALE

0 10 ft 20 ft

N

FIGURE 3

SOIL VAPOR POINT PLAN

HORACE MANN SCHOOL
687 WATERTOWN STREET
Newton, Massachusetts

Prepared By:
LORD ASSOCIATES, INC.
1506 PROVIDENCE HIGHWAY, SUITE 30
NORWOOD, MASSACHUSETTS 02062

JULY 2013

TABLES

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
RW-1	6.16	6.33	0.17	0.00	7/15/2005
	6.24	6.39	0.15	0.00	7/22/2005
	6.34	6.42	0.08	0.00	8/16/2005
	6.23	6.30	0.07	0.00	3/7/2006
	6.61	6.70	0.09	0.00	5/5/2006
	5.20	5.23	0.03	0.00	5/18/2006
	5.90	5.94	0.04	0.00	5/30/2006
	5.53	5.56	0.03	0.00	6/30/2006
	6.65	6.90	0.25	0.00	10/18/2006
	5.29	5.33	0.04	0.00	4/18/2007
	6.16	6.22	0.06	0.00	6/7/2007
	6.51	6.58	0.07	0.00	7/12/2007
	6.72	6.77	0.05	0.00	8/14/2007
	6.73	6.78	0.05	4.73	9/12/2007
	6.93	6.97	0.04	0.13	9/20/2007
	-	-	0.00	2.00	9/26/2007
	7.94	7.99	0.05	0.75	10/3/2007
	6.91	6.93	0.02	0.00	10/11/2007
	6.94	6.97	0.03	1.00	10/18/2007
	6.88	6.91	0.03	5.68	10/25/2007
	6.97	6.98	0.01	1.50	11/2/2007
	6.87	6.88	0.01	0.33	11/8/2007
	6.95	6.96	0.01	0.33	11/28/2007
	6.97	6.98	0.01	0.33	12/6/2007
	6.92	6.93	0.01	0.00	12/12/2007
	6.63	6.64	0.01	0.06	12/26/2007
	-	-	-	-	1/2/2008 **
	6.62	6.63	0.01	0.50	1/7/2008
	-	6.48	0.00	0.75	1/17/2008
	-	6.41	0.00	0.50	1/24/2008
	-	5.40	0.00	0.03	2/14/2008
	-	5.73	0.00	0.00	2/28/2008
	-	5.83	0.00	0.00	3/7/2008
	-	5.92	0.00	0.00	3/26/2008
	-	6.33	0.00	0.00	8/14/2008
	-	6.59	0.00	0.00	8/27/2008
	-	6.61	0.00	0.00	9/18/2008
	6.50	6.51	0.01	0.02	8/21/2009
	6.60	6.61	0.01	0.02	9/10/2009
	-	6.70	0.00	0.00	9/24/2009
	-	6.65	0.00	0.00	9/30/2009
	6.37	6.38	0.01	0.01	10/7/2009
	6.76	6.78	0.02	0.00	10/14/2009
	-	6.40	0.00	0.00	12/3/2009
	-	6.46	0.00	0.00	12/11/2009
	-	6.25	0.00	0.00	12/18/2009
	-	6.41	0.00	0.00	1/20/2010
	-	6.29	0.00	0.00	2/2/2010
	-	5.80	0.00	0.00	3/24/2010
	-	6.69	0.00	0.00	6/4/2010
	-	6.67	0.00	0.00	6/15/2010
	-	6.30	0.00	0.00	5/20/2014
	-	6.25	0.00	0.00	8/16/2018
RW-2	-	5.03	0.00	0.00	7/11/2005
	-	5.23	0.00	0.00	7/22/2005
	-	5.76	0.00	0.00	7/29/2005
	-	9.84	0.00	0.00	11/7/2007
	-	8.50	0.00	0.00	4/11/2017
RW-3	4.16	4.52	0.36	2.00	7/11/2005
	4.22	4.87	0.65	0.50	7/15/2005
	4.52	5.11	0.59	0.50	7/22/2005
	4.62	5.37	0.75	0.00	7/29/2005
	-	11.01	0.00	0.00	11/7/2007
RW-4	-	3.81	0.00	0.00	7/11/2005
	-	4.11	0.00	0.00	7/15/2005
	-	4.62	0.00	0.00	7/22/2005
	-	4.18	0.00	0.00	7/29/2005
RW-6	4.52	4.58	0.06	0.00	6/30/2006
	6.03	6.26	0.23	0.00	8/31/2006
	-	4.86	0.00	0.00	3/28/2007
	4.54	4.58	0.04	0.00	4/18/2007
	5.58	5.64	0.06	0.00	6/7/2007
	5.93	5.95	0.02	0.00	7/12/2007
	6.52	6.53	0.01	0.00	8/14/2007
	-	6.74	0.00	0.00	9/20/2007
	-	-	-	0.06	9/26/2007
	7.94	7.95	0.01	0.00	10/3/2007
	-	6.78	0.00	0.00	10/11/2007
	-	6.79	0.00	0.00	10/18/2007
	6.88	6.92	0.04	2.00	10/25/2007
	6.95	6.97	0.02	0.50	11/2/2007
	-	6.75	0.00	0.00	11/8/2007
	-	6.85	0.00	0.00	11/28/2007
	6.98	6.99	0.01	0.00	12/6/2007
	6.93	6.94	0.01	0.00	12/12/2007
	6.58	6.59	0.01	0.00	1/7/2008
	-	5.22	0.00	0.00	1/17/2008
	-	4.58	0.00	0.00	8/14/2008
	-	4.64	0.00	0.00	8/27/2008
	-	4.71	0.00	0.00	9/18/2008
	-	6.15	0.00	0.00	7/11/2011
	-	5.01	0.00	0.00	10/11/2011
	-	4.88	0.00	0.00	11/29/2011
	-	4.79	0.00	0.00	12/16/2011
	-	4.90	0.00	0.00	12/23/2011
	-	5.68	0.00	0.00	6/11/2013

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
RW-7	-	4.62	0.00	0.00	3/7/2006
	-	6.83	0.00	0.00	11/7/2007
	-	4.83	0.00	0.00	8/14/2008
	-	4.93	0.00	0.00	8/27/2008
	-	5.00	0.00	0.00	9/18/2008
	-	5.85	0.00	0.00	2/10/2011
	-	5.74	0.00	0.00	6/24/2011
	-	5.95	0.00	0.00	4/17/2012
	-	5.90	0.00	0.00	6/11/2013
P-1BMW	-	3.61	0.00	0.00	7/11/2005
	-	4.83	0.00	0.00	8/16/2005
		5.08	0.00	0.00	8/31/2006
		4.5	0.00	0.00	11/9/2006
	-	3.28	0.00	0.00	4/18/2007
	-	4.48	0.00	0.00	6/7/2007
	-	4.85	0.00	0.00	7/12/2007
	-	5.11	0.00	0.00	8/14/2007
	-	6.01	0.00	0.00	9/12/2007
	-	6.05	0.00	0.00	9/20/2007
	-	6.28	0.00	0.00	10/3/2007
	-	6.33	0.00	0.00	10/11/2007
	-	6.31	0.00	0.00	10/18/2007
	-	6.33	0.00	0.00	10/25/2007
	-	6.28	0.00	0.00	11/2/2007
	-	6.22	0.00	0.00	11/7/2007
	-	6.3	0.00	0.00	11/28/2007
	-	6.36	0.00	0.00	12/6/2007
	-	6.31	0.00	0.00	12/12/2007
	-	5.09	0.00	0.00	12/26/2007
	-	4.38	0.00	0.00	1/17/2008
	-	4.52	0.00	0.00	1/24/2008
	-	4.33	0.00	0.00	2/28/2008
	-	4.37	0.00	0.00	3/26/2008
	-	4.48	0.00	0.00	4/2/2008
	-	3.53	0.00	0.00	8/14/2008
	-	4.08	0.00	0.00	8/27/2008
	-	4.18	0.00	0.00	9/18/2008
	-	5.15	0.00	0.00	9/10/2009
	-	4.91	0.00	0.00	2/10/2011
	-	5.21	0.00	0.00	6/24/2011
	-	5.18	0.00	0.00	4/17/2012
	-	5.3	0.00	0.00	8/29/2012
	-	4.77	0.00	0.00	1/15/2013
	-	3.98	0.00	0.00	6/18/2013
	-	4.91	0.00	0.00	5/20/2014
	-	6.2	0.00	0.00	9/30/2014
	-	5.6	0.00	0.00	2/19/2015
	-	5.52	0.00	0.00	7/30/2015
	-	5.12	0.00	0.00	1/5/2016
	-	5.79	0.00	0.00	12/6/2016
	-	4.89	0.00	0.00	2/23/2017
	-	6.06	0.00	0.00	10/12/2017
	-	4.95	0.00	0.00	5/1/2018
	-	5.8	0.00	0.00	8/16/2018
	-	5.41	0.00	0.00	8/6/2019
P-3BMW	-	4.57	0.00	0.00	7/11/2005
	-	4.83	0.00	0.00	8/16/2005
	-	4.93	0.00	0.00	6/7/2007
	-	5.13	0.00	0.00	7/12/2007
	-	5.26	0.00	0.00	8/14/2007
	-	5.86	0.00	0.00	9/12/2007
	-	5.92	0.00	0.00	9/20/2007
	-	6.81	0.00	0.00	10/3/2007
	-	6.82	0.00	0.00	10/11/2007
	-	6.88	0.00	0.00	10/18/2007
	-	6.88	0.00	0.00	10/25/2007
	-	6.96	0.00	0.00	11/2/2007
	-	6.83	0.00	0.00	11/7/2007
	-	6.97	0.00	0.00	11/28/2007
	-	6.95	0.00	0.00	12/6/2007
	-	6.91	0.00	0.00	12/12/2007
	-	6.61	0.00	0.00	12/26/2007
	-	4.96	0.00	0.00	1/17/2008
	-	4.94	0.00	0.00	1/24/2008
	-	4.71	0.00	0.00	2/28/2008
	-	4.73	0.00	0.00	3/26/2008
	-	5.33	0.00	0.00	9/10/2009
	-	5.50	0.00	0.00	6/24/2011
	-	5.70	0.00	0.00	8/29/2012
	-	4.58	0.00	0.00	6/18/2013
	-	5.20	0.00	0.00	5/20/2014
	-	6.53	0.00	0.00	9/30/2014
	-	5.65	0.00	0.00	2/19/2015
	-	5.80	0.00	0.00	7/30/2015
	-	5.60	0.00	0.00	1/5/2016
	-	6.27	0.00	0.00	12/6/2016
	-	5.00	0.00	0.00	5/1/2018

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
P-4BMW	-	4.22	0.00	0.00	7/11/2005
	-	5.12	0.00	0.00	8/16/2005
	4.73	4.77	0.04	0.00	3/7/2006
	-	5.01	0.00	0.00	8/31/2006
	-	4.66	0.00	0.00	11/9/2006
	-	3.61	0.00	0.00	4/18/2007
	-	4.87	0.00	0.00	6/7/2007
	-	5.18	0.00	0.00	7/12/2007
	-	5.27	0.00	0.00	8/14/2007
	-	5.94	0.00	0.00	9/12/2007
	-	5.91	0.00	0.00	9/20/2007
	-	6.03	0.00	0.00	10/3/2007
	-	6.07	0.00	0.00	10/11/2007
	-	5.71	0.00	0.00	10/18/2007
	-	6.17	0.00	0.00	10/25/2007
	-	6.29	0.00	0.00	11/2/2007
	-	6.33	0.00	0.00	11/7/2007
	-	6.36	0.00	0.00	11/28/2007
	-	-	-	-	12/6/2007
	-	-	-	-	12/12/2007
	-	6.37	-	-	12/26/2007
	4.67	4.71	0.04	< 1/32	1/17/2008
	4.85	4.87	0.02	0.00	1/24/2008
	4.45	4.46	0.01	0.00	2/28/2008
	-	4.51	0.00	0.00	3/26/2008
	-	4.32	0.00	0.00	4/2/2008
	-	4.29	0.00	0.00	8/27/2008
	-	4.39	0.00	0.00	9/18/2008
	-	5.14	0.00	0.00	9/10/2009
	3.62	3.63	0.01	0.00	3/24/2010
	5.14	5.30	0.16	0.00	2/10/2011
	-	5.10	0.00	0.00	6/24/2011
	sheen	5.00	0.00	0.00	7/11/2011
	4.4	4.60	0.20	0.00	10/11/2011***
	-	4.60	0.00	0.00	11/29/2011
	-	4.52	0.00	0.00	12/16/2011
	-	4.72	0.00	0.00	12/23/2011
	-	4.85	0.00	0.00	1/13/2012
	-	5.60	0.00	0.00	4/17/2012
	5.35	5.70	0.35	0.05	8/29/2012
	4.84	5.05	0.21	0.05	1/15/2013
	4.00	4.07	0.07	0.05	6/8/2013
	4.95	4.96	0.01	0.01	5/20/2014
		Dry at 5.61'			9/30/2014
		Dry at 5.60'			2/19/2015
		Dry at 4.00'			1/5/2016
		Clogged near top of well			12/6/2016
		Destroyed. Unable to sample			5/1/2018
P-5BMW	5.72	7.01	1.29	0.00	7/15/2005
	5.81	7.12	1.31	0.50	7/22/2005
	5.91	7.10	1.19	0.00	7/29/2005
	5.98	7.00	1.02	0.00	8/16/2005
	5.93	7.10	1.17	0.00	3/7/2006
	5.5	6.95	1.45	0.00	5/30/2006
	5.98	7.04	1.06	0.00	8/31/2006
	6.36	7.21	0.85	0.25	10/23/2006
	-	5.18	0.00	0.00	4/18/2007
	NG	NG	NG	0.00	6/7/2007
	6.25	7.31	1.06	0.00	7/12/2007
	6.44	7.34	0.90	0.00	8/14/2007
	6.51	7.43	0.92	0.33	9/12/2007
	6.43	7.47	1.04	0.50	9/20/2007
	-	-	0.00	0.25	9/26/2007
	7.01	7.63	0.62	1.25	10/11/2007
	6.8	7.91	1.11	0.25	10/18/2007
	6.73	8.37	1.64	1.75	10/25/2007
	6.82	7.97	1.15	1.00	11/2/2007
	6.73	7.64	0.91	0.50	11/8/2007
	6.79	8.33	1.54	0.13	11/28/2007
	6.81	7.98	1.17	0.25	12/6/2007
	6.45	8.36	1.91	0.25	12/26/2007
	6.47	8.28	1.81	0.50	1/7/2008
	6.27	7.88	1.61	0.33	1/17/2008
	6.54	7.71	1.17	0.33	1/24/2008
	5.33	6.96	1.63	0.00	2/14/2008
	5.68	7.72	2.04	0.33	3/7/2008
	5.91	7.99	2.08	0.00	3/26/2008
	6.23	8.16	1.93	1.93	8/27/2008
	6.25	8.19	1.94	1.94	9/18/2008
	5.78	7.63	1.85	1.85	10/2/2008
	6.10	8.20	2.10	2.10	12/5/2008
	6.30	8.38	2.08	0.50	8/21/2009
	6.47	7.45	0.98	0.30	9/10/2009
	6.55	7.40	0.85	0.25	9/24/2009
	6.61	7.50	1.11	0.01	9/30/2009
	6.34	6.40	0.06	0.01	10/7/2009
	7.55	7.74	0.19	0.01	10/14/2009
	6.02	6.67	0.65	0.05	12/3/2009
	6.01	6.34	0.33	0.25	12/11/2009
	6.14	6.36	0.22	0.05	12/18/2009
	6.36	6.69	0.33	0.05	1/20/2010
	6.30	6.61	0.31	0.05	2/2/2010
	4.85	4.89	0.04	0.00	3/24/2010
	5.44	5.92	0.48	0.05	4/8/2010
	5.71	5.85	0.14	0.05	4/12/2010
	6.50	6.77	0.27	0.05	5/14/2010
	6.60	6.69	0.09	0.01	6/15/2010
	6.43	6.50	0.07	0.00	8/24/2010
	6.68	6.96	0.28	0.00	10/27/2010
	6.75	6.99	0.24	0.05	11/16/2010
	6.60	8.87	0.27	0.05	1/13/2011
	6.56	6.63	0.07	0.00	1/25/2011
	6.47	6.60	0.13	0.00	2/10/2011
		could not determine			3/11/2011
		could not determine			3/24/2011
		could not determine			4/4/2011
		could not determine			5/4/2011
	-	6.40	0.00	0.00	6/24/2011
	sheen	6.62	0.00	0.00	7/11/2011
	6.30	6.40	0.10	0.00	10/11/2011***
		probe stuck @ 5'			11/29/2011
	5.70	5.79	0.09	0.01	12/16/2011
	5.80	5.81	0.01	0.01	12/23/2011
	-	6.22	0.00	0.00	1/18/2012
	-	6.79	0.00	0.00	4/17/2012#
	5.25	5.95	0.70	0.05	8/29/2012
	6.30	6.46	0.16	0.05	1/15/2013
	5.80	6.80	1.00	0.10	6/11/2013
	-	6.57	0.00	0.00	5/20/2014
	-	6.81	0.00	0.00	9/30/2014
	-	6.23	0.00	0.00	1/21/2015
		Plugged at 5.5' - Removed and replaced with P-5BR			2/19/2015

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
P-5BR	Sheen	5.72	0.00	0.00	3/14/2015
	-	5.66	0.00	0.00	4/23/2015
	-	6.19	0.00	0.00	12/31/2015
	-	6.42	0.00	0.00	12/6/2016
	-	5.57	0.00	0.00	2/22/2017
	-	5.56	0.00	0.00	3/28/2017
	-	5.02	0.00	0.00	5/16/2017
	-	6.23	0.00	0.00	9/12/2017
	-	6.26	0.00	0.00	10/12/2017
	-	5.08	0.00	0.00	5/1/2018
	-	6.29	0.00	0.00	7/13/2018
	-	6.08	0.00	0.00	8/7/2019
P-6BMW	5.32	5.91	0.59	0.00	7/15/2005
	5.81	6.27	0.46	0.00	7/22/2005
	5.78	6.31	0.53	0.00	7/29/2005
	6.11	6.95	0.84	0.00	8/16/2005
	5.91	6.40	0.49	0.00	3/7/2006
	-	5.14	0.00	0.00	3/28/2007
	4.92	5.36	0.44	0.00	4/18/2007
	-	5.92	0.00	0.00	6/7/2007
	6.06	6.47	0.41	0.00	7/12/2007
	6.50	6.88	0.38	0.00	8/14/2007
	6.67	6.96	0.29	0.00	9/12/2007
	6.89	7.02	0.13	0.00	9/20/2007
	6.87	7.01	0.14	0.00	10/18/2007
	6.84	7.04	0.20	1.00	10/25/2007
	6.88	7.09	0.21	0.06	11/28/2007
	6.61	7.06	0.45	0.06	12/26/2007
	5.67	7.58 ***	1.91	0.00	3/26/2008
	5.16	5.23	0.06	0.06	8/14/2008
	6.12	6.28	0.16	0.16	8/27/2008
	6.18	6.26	0.08	0.08	9/18/2008
	4.76	4.87	0.11	0.11	10/2/2008
	5.41	5.43	0.02	0.00	12/5/2008
	6.00	6.05	0.05	0.05	8/21/2009
	-	6.45	0.00	0.00	9/10/2009
	6.60	6.61	0.01	0.01	9/24/2009
	5.58	5.60	0.02	0.01	9/30/2009
	6.40	6.41	0.01	0.01	10/7/2009
	6.56	6.57	0.01	0.01	10/14/2009
	5.65	5.70	0.05	0.02	12/3/2009
	4.82	4.83	0.01	0.01	12/11/2009
	4.74	4.75	0.01	0.01	12/18/2009
	-	5.98	0.00	0.00	2/2/2010
	4.29	4.30	0.01	0.00	3/24/2010
	4.61	4.65	0.40	0.00	4/8/2010
	6.47	6.48	0.01	0.00	5/18/2010
	6.61	6.63	0.02	0.00	6/4/2010
	6.61	6.62	0.01	0.00	6/15/2010
	-	6.49	0.00	0.00	8/24/2010
	-	6.51	0.00	0.00	10/27/2010
	6.66	6.75	0.09	0.00	11/16/2010
	6.37	6.50	0.13	0.00	1/13/2011
	6.52	6.71	0.19	0.00	1/25/2011
	6.66	6.80	0.14	0.00	2/10/2011
	4.90	4.93	0.03	0.00	3/11/2011
	5.32	5.35	0.03	0.00	3/24/2011
	5.90	5.92	0.02	0.00	4/4/2011
	6.23	6.25	0.02	0.00	6/24/2011
	product	-	-	-	7/11/2011
	6.30	6.70	0.40	0.00	10/11/2011***
	-	5.40	0.00	0.00	11/29/2011
	5.12	5.13	0.01	0.01	12/16/2011
	5.30	5.31	0.01	0.01	12/23/2011
	6.14	6.15	0.01	0.00	1/18/2012
	6.73	6.73	0.02	0.00	4/17/2012
	-	6.30	0.00	0.00	8/29/2012
	-	5.86	0.00	0.00	1/15/2013
	5.75	5.82	0.07	0.05	6/11/2013
	5.65	5.66	0.01	0.01	5/20/2014
	6.48	6.80	0.32	0.10	9/30/2014
		Removed and replaced with P-6BR			2/19/2015

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
P-6BR	-	5.12	0.00	0.00	4/23/2015
	Sheen	6.37	0.01	0.01	7/30/2015
	Sheen	6.60	0.00	0.00	1/5/2016
	6.11	6.12	0.01	0.00	12/6/2016
	5.31	5.33	0.02	0.00	2/23/2017
	5.28	5.30	0.02	0.00	3/28/2017**
	-	4.99	0.00	0.00	5/16/2017
	-	6.18	0.00	0.01 (from sock)	9/12/2017
	-	6.36	0.00	0.00	10/12/2017
	-	6.22	0.00	0.00	7/13/2018
	-	6.37	0.00	0.01 (from sock)	8/16/2018
	-	6.23	0.00	0.00	8/7/2019
P-7BMW	6.29	6.58	0.29	0.00	7/15/2005
	6.21	6.39	0.18	0.00	7/22/2005
	6.21	6.34	0.13	0.00	7/29/2005
	6.16	6.28	0.12	0.00	8/16/2005
	6.23	6.30	0.07	0.00	3/7/2006
	-	6.27	0.00	0.00	8/31/2006
	-	5.23	0.00	0.00	4/18/2007
	-	6.01	0.00	0.00	6/7/2007
	-	6.52	0.00	0.00	7/12/2007
	6.73	6.74	0.01	0.00	8/14/2007
	-	6.75	0.00	0.00	9/12/2007
	-	6.96	0.00	0.06	9/20/2007
	-	-	-	0.06	9/26/2007
	-	6.98	0.00	0.00	10/3/2007
	-	6.94	0.00	0.00	10/11/2007
	-	6.96	0.00	0.00	10/18/2007
	-	6.91	0.00	0.00	10/25/2007
	-	7.00	0.00	0.00	11/2/2007
	-	6.91	0.00	0.00	11/8/2007
	-	6.07	0.00	0.00	11/28/2007
	-	6.98	0.00	0.00	12/6/2007
	6.94	6.95	0.00	0.00	12/12/2007
	-	6.66	0.00	0.00	12/26/2007
	-	6.67	0.00	0.00	1/7/2008
	-	6.44	0.00	0.00	1/17/2008
	-	6.47	0.00	0.00	1/24/2008
	-	5.49	0.00	0.00	2/14/2008
	-	6.94	0.00	0.00	2/28/2008
	8.87	8.99	0.12	0.00	3/7/2008
	5.90	5.91	0.01	0.00	3/26/2008
	-	6.11	0.00	0.00	8/14/2008
	Sheen	6.39	0.00	0.00	8/27/2008
	6.59	6.62	0.03	0.03	9/18/2008
	5.88	5.90	0.02	0.00	10/2/2008
	6.25	8.25	2.00	2.00	12/5/2008
	6.45	6.85	0.40	0.05	8/21/2009
	6.60	6.61	0.01	0.01	9/10/2009
	6.65	6.67	0.02	0.01	9/24/2009
	6.60	6.67	0.07	0.01	9/30/2009
	6.42	6.43	0.01	0.01	10/7/2009
	6.78	6.79	0.01	0.01	10/14/2009
	-	6.04	0.00	0.00	12/3/2009
	-	6.06	0.00	0.00	12/11/2009
	6.18	6.19	0.01	0.05	12/18/2009
	6.37	6.38	0.01	0.02	1/20/2010
	6.25	6.26	0.01	0.01	2/2/2010
	-	6.50	0.00	0.00	3/24/2010
	5.45	5.46	0.01	0.00	4/8/2010
	-	6.58	0.00	0.00	5/18/2010***
	6.62	6.63	0.01	0.00	6/4/2010
	6.61	6.62	0.01	0.00	6/15/2010
	-	6.79	0.00	0.00	9/30/2010
	-	6.73	0.00	0.00	10/27/2010
	-	6.75	0.00	0.00	11/16/2010
	-	6.66	0.00	0.00	1/13/2011
	-	6.62	0.00	0.00	1/25/2011
	5.33	5.34	0.01	0.00	3/11/2011
	-	6.04	0.00	0.00	3/24/2011
	-	6.16	0.00	0.00	4/4/2011
	-	6.80	0.00	0.00	7/11/2011
	6.30	6.40	0.10	0.00	10/11/2011***
		clogged/dry @ 5.7'			11/29/2011
		clogged/dry @ 5.7'			12/16/2011
		clogged/dry @ 7.93'			4/17/2012
	-	6.45	0.00	0.00	8/29/2012
	-	8.33	0.00	0.00	1/15/2013
	-	5.82	0.00	0.00	6/11/2013
		PLUGGED AT 5.90'			9/30/2014
		PLUGGED AT 5.80'			2/19/2015
	-	5.58	0.00	0.00	2/22/2017

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
P-8BMW	*	*	*	*	7/15/2005
	*	*	*	*	7/22/2005
	*	*	*	*	7/29/2005
	*	*	*	*	8/16/2005
	-	5.93	0.00	0.00	8/31/2006
	-	4.88	0.00	0.00	4/18/2007
	-	5.24	0.00	0.00	6/7/2007
	-	5.55	0.00	0.00	7/12/2007
	-	-	0.00	0.00	8/14/2007
	-	6.77	0.00	0.00	9/12/2007
	-	-	0.00	0.00	9/20/2007
	-	-	0.00	0.00	10/3/2007
	-	-	0.00	0.00	10/11/2007
	-	-	0.00	0.00	10/18/2007
	-	-	0.00	0.00	10/25/2007
	-	-	0.00	0.00	11/2/20007
	-	-	0.00	0.00	11/8/2007
	-	-	0.00	0.00	11/28/2007
	-	-	0.00	0.00	12/6/2007
	-	-	0.00	0.00	12/12/2007
	-	6.68	0.00	0.00	12/26/2007
	-	6.66	0.00	0.00	1/7/2008
	-	6.46	0.00	0.00	1/17/2008
	-	6.50	0.00	0.00	1/24/2008
	-	5.31	0.00	0.00	2/14/2008
	-	4.98	0.00	0.00	2/28/2008
	-	5.03	0.00	0.00	3/7/2008
	-	5.00	0.00	0.00	3/26/2008
	-	6.55	0.00	0.00	9/10/2009
	-	2.10	0.00	0.00	3/24/2010
	-	5.45	0.00	0.00	5/18/2010
	-	6.61	0.00	0.00	6/4/2010
	-	6.52	0.00	0.00	6/15/2010
	-	6.71	0.00	0.00	9/30/2010
	-	6.65	0.00	0.00	1/13/2011
		Dry @ 7.4			6/24/2011
	-	6.51	0.00	0.00	4/17/2012
	-	6.35	0.00	0.00	8/29/2012
	-	5.93	0.00	0.00	6/11/2013
		PLUGGED AT 6.47'			9/30/2014
	-	5.9	0.00	0.00	4/23/2015
	-	6.18	0.00	0.00	12/31/2015
	-	6.28	0.00	0.00	12/6/2016
	-	5.78	0.00	0.00	2/22/2017
		5.43	0.00	0.00	8/16/2018
	-	6.23	0.00	0.00	8/7/2019
B-2MW	-	9.24	0.00	0.00	7/29/2005
	-	8.90	0.00	0.00	3/7/2006
	9.01	9.23	0.22	0.25	8/31/2006
	-	8.29	0.00	0.00	8/14/2008
	-	9.28	0.00	0.00	8/27/2008
	-	9.33	0.00	0.00	9/18/2008
	-	7.73	0.00	0.00	10/2/2008
	9.5	9.53	0.03	0.05	8/21/2009
	9.47	9.48	0.01	0.01	9/10/2009
	-	9.61	0.00	0.00	9/24/2009
	9.62	9.63	0.01	0.01	9/30/2009
	9.38	9.39	0.01	0.01	10/7/2009
	-	9.40	0.00	0.00	10/14/2009
	-	8.51	0.00	0.00	12/3/2009
	-	7.42	0.00	0.00	12/11/2009
	-	8.05	0.00	0.00	12/18/2009
	-	8.98	0.00	0.00	1/20/2010
	-	7.55	0.00	0.00	4/2/2010
		clogged near top of well			6/15/2010
		clogged near top of well			6/24/2011
	-	8.9	0	0	5/21/2013
	-	Dry 7.90			5/20/2014
		PLUGGED AT 7.20'			9/30/2014
	-	9.44	0.00	0.00	8/7/2019
B-12MW	-	8.03	0.00	0.00	9/10/2009
B-14MW	-	7.06	0.00	0.00	7/11/2005
	-	7.6	0.00	0.00	6/24/2011
B-18MW	-	11.24	0.00	0.00	7/13/2001
	-	9.48	0.00	0.00	8/16/2005
	-	11.88	0.00	0.00	3/7/2006
	-	-	-	-	4/18/2007
	-	11.73	0.00	0.00	6/7/2007
	-	10.27	0.00	0.00	7/12/2007
	-	10.93	0.00	0.00	8/14/2007
	-	12.18	0.00	0.00	9/12/2007
	-	12.48	0.00	0.00	9/20/2007
	-	12.46	0.00	0.00	10/11/2007
	-	12.48	0.00	0.00	10/18/2007
	-	12.46	0.00	0.00	10/18/2007
	-	12.56	0.00	0.00	11/2/2007
	-	12.31	0.00	0.00	11/8/2007
	-	12.56	0.00	0.00	11/28/2007
	-	1.05	0.00	0.00	4/2/2008
	-	12.20	0.00	0.00	9/10/2009
	-	9.11	0.00	0.00	4/2/2010
	-	11.98	0.00	0.00	6/24/2011
	-	11.58	0.00	0.00	1/13/2012
	-	12.15	0.00	0.00	4/17/2012
	-	12.20	0.00	0.00	8/29/2012
	-	12.00	0.00	0.00	5/20/2014
	-	10.48	0.00	0.00	4/23/2015
	-	12.13	0.00	0.00	7/30/2015
	-	11.88	0.00	0.00	12/15/2015
	-	11.91	0.00	0.00	12/8/2016
	-	10.59	0.00	0.00	2/23/2017
	-	12.11	0.00	0.00	10/17/2017
	-	11.40	0.00	0.00	5/8/2018
	-	11.61	0.00	0.00	5/29/2018
	-	11.83	0.00	0.00	6/27/2018
	-	11.99	0.00	0.00	8/16/2018
	-	12.00	0.00	0.00	10/16/2019
	-	10.97	0.00	0.00	12/4/2018
	-	11.85	0.00	0.00	8/6/2019

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
B-19MW	-	9.22	0.00	0.00	8/16/2005
	destroyed				6/24/2011
B-20MW	-	6.87	0.00	0.00	7/11/2005
	-	6.24	0.00	0.00	4/18/2007
	-	7.16	0.00	0.00	6/7/2007
	-	7.52	0.00	0.00	7/12/2007
	-	-	-	-	8/14/2007
	-	5.56	0.00	0.00	4/2/2010
	-	7.4	0.00	0.00	6/24/2011
	-	6.88	0.00	0.00	4/23/2015
	-	7.44	0.00	0.00	7/30/2015
	-	7.26	0.00	0.00	12/15/2015
	-	7.27	0.00	0.00	12/8/2016
	-	7.48	0.00	0.00	10/17/2017
	-	6.75	0.00	0.00	5/8/2018
	-	7.03	0.00	0.00	5/29/2018
	-	7.25	0.00	0.00	6/27/2018
	-	7.44	0.00	0.00	10/16/2018
	-	7.22	0.00	0.00	8/6/2019
B-21MW	-	7.24	0.00	0.00	7/11/2005
	-	5.38	0.00	0.00	4/18/2007
	-	7.45	0.00	0.00	6/7/2007
	-	-	-	0.00	7/12/2007
	-	-	-	0.00	8/14/2007
	destroyed				4/2/2010
	destroyed				6/24/2011
B-22MW	-	6.32	0.00	0.00	7/11/2005
	-	6.82	0.00	0.00	7/22/2005
	-	6.76	0.00	0.00	7/29/2005
	-	6.72	0.00	0.00	8/16/2005
	-	6.01	0.00	0.00	4/18/2007
	-	6.77	0.00	0.00	6/7/2007
	-	7.10	0.00	0.00	7/12/2007
	-	7.31	0.00	0.00	8/14/2007
	7.23	7.27	0.04	0.00	9/12/2007**
	-	7.53	0.00	0.06	9/20/2007
	-	-	-	0.08	9/26/2007
	-	7.59	0.00	0.13	10/3/2007
	-	7.48	0.00	0.00	10/11/2007**
	-	7.45	0.00	0.00	10/18/2007
	-	7.48	0.00	0.00	10/25/2007
	-	7.55	0.00	0.00	11/2/2007
	-	7.46	0.00	0.00	11/8/2007
	7.53	7.54	0.01	0.00	11/28/2007
	-	7.68	0.00	0.00	12/6/2007
	-	7.29	0.00	0.00	12/26/2007
	-	7.32	0.00	0.00	1/7/2008
	-	7.11	0.00	0.00	1/17/2008
	-	7.16	0.00	0.00	1/24/2008
	-	6.31	0.00	0.00	2/14/2008
	-	6.63	0.00	0.00	3/7/2008
	-	6.78	0.00	0.00	4/2/2008
	-	6.81	0.00	0.00	8/14/2008
	-	7.10	0.00	0.00	8/27/2008
	-	7.09	0.00	0.00	9/18/2008
	-	7.06	0.00	0.00	9/10/2009
	-	5.41	0.00	0.00	4/2/2010
	-	7.86	0.00	0.00	6/24/2011
	-	6.63	0.00	0.00	1/13/2012
	-	7.10	0.00	0.00	4/17/2012
	-	6.37	0.00	0.00	4/23/2015
	-	6.92	0.00	0.00	7/30/2015
	-	6.63	0.00	0.00	12/15/2015
	-	6.72	0.00	0.00	12/8/2016
	-	5.22	0.00	0.00	2/22/2017
	-	6.10	0.00	0.00	5/16/2017
	-	6.81	0.00	0.00	9/12/2017
	-	6.90	0.00	0.00	10/17/2017
	-	6.25	0.00	0.00	5/8/2018
	-	6.51	0.00	0.00	5/29/2018
	-	6.76	0.00	0.00	6/27/2018
	-	6.92	0.00	0.00	10/16/2018
	-	6.80	0.00	0.00	8/7/2019

Table 1. Gauging and Bailing Data
Horace Mann School
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WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
B-25MW	0.00	4.77	0.00	0.00	9/10/2009
	0.00	2.97	0.00	0.00	4/2/2010
	0.00	3.90	0.00	0.00	6/24/2011
B-26MW	8.78	10.86	2.08	2.00	7/11/2005
	8.83	10.22	1.39	2.00	7/15/2005
	8.86	10.18	1.32	1.00	7/22/2005
	9.09	10.66	1.57	1.00	7/29/2005
	9.04	10.21	1.17	0.00	8/16/2005
	8.90	11.21	2.31	0.00	3/7/2006
	8.25	9.00	0.75	3.00	6/30/2006**
				1.00	7/13/2006
	9.25	9.87	0.62	1.00	8/31/2006
	9.29	9.87	0.58	0.25	10/18/2006 **
	9.35	9.60	0.25	0.13	10/23/2006
	9.09	9.44	0.35	0.25	11/1/2006
	-	-	-	0.10	11/15/2006
	-	-	-	0.25	12/20/2006
	-	-	-	0.50	2/7/2007
	8.02	8.86	0.84	0.10	4/18/2007
	8.25	10.03	1.78	0.25	6/7/2007
	9.58	10.31	0.73	0.10	7/12/2007
	9.93	10.29	0.36	0.10	8/14/2007 **
	9.86	10.16	0.30	0.13	9/12/2007
	10.04	10.37	0.33	0.13	9/20/2007
	-	-	-	0.08	9/26/2007
	10.08	10.34	0.26	0.75	10/3/2007
	10.04	10.29	0.25	0.06	10/11/2007**
	10.13	10.21	0.08	0.25	10/18/2007
	10.12	10.15	0.03	0.50	10/25/2007
	10.16	10.18	0.02	0.50	11/2/2007
	-	10.03	0.00	0.00	11/8/2007**
	-	10.13	0.00	0.00	11/28/2007
	-	10.17	0.00	0.06	12/6/2007
	-	10.18	0.00	0.06	12/12/2007
	-	9.88	0.00	0.00	12/26/2007
	9.83	9.87	0.04	0.06	1/7/2008
	9.66	9.70	0.04	0.33	1/17/2008 **
	-	8.75	0.00	0.06	2/14/2008
	9.07	9.08	0.01	0.25	3/7/2008
	9.27	9.41	0.14	0.14	8/14/2008
	9.43	9.48	0.05	0.05	8/27/2008
	9.63	9.71	0.08	0.08	9/18/2008
	9.14	9.35	0.21	0.21	10/2/2008
	9.35	9.55	0.20	0.01	8/21/2009
	9.60	9.62	0.02	0.01	9/10/2009
	9.58	9.60	0.02	0.01	9/24/2009
	9.59	9.61	0.02	0.02	9/30/2009
	9.30	9.32	0.02	0.01	10/7/2009
	9.47	9.49	0.02	0.40	10/14/2009
	8.90	9.30	0.40	0.20	12/3/2009
	9.04	9.05	0.01	0.05	12/11/2009
	9.05	9.07	0.02	0.25	12/18/2009
	-	10.24	0.00	0.2 (from sock)	1/20/2010
	-	9.17	0.00	0.05 (from sock)	2/2/2010
	-	8.61	0.00	0.00	4/12/2010
	9.52	10.10	0.58	0.50	9/30/2010
	9.51	9.94	0.43	0.50	10/27/2010
	9.54	9.92	0.38	0.75	11/16/2010
	9.03	9.50	0.47	1.00	4/25/2011
	9.34	9.81	0.47	0.2 (from sock)	6/24/2011
	9.60	10.20	0.60	-	7/11/2011
	8.70	?	?	-	10/11/2011***
	8.30	9.40	1.10	0.00	11/29/2011***
	8.21	9.90	1.71	1.50	12/16/2011
	8.39	9.02	0.63	0.60	12/23/2011
	9.18	9.35	0.17	-	4/17/2012
	9.19	9.35	0.16	-	8/29/2012
	9.20	9.22	0.02	-	5/21/2013
	9.30	9.35	0.05	0.01	9/5/2013
	-	10.20	0.00	0.00	5/20/2014
	9.30	9.33	0.03	0.01	4/23/2015
	-	9.78	0.00	0.00	7/30/2015
	Sheen	9.21	0.00	0.00	12/8/2016
	8.15	9.98	1.83	1.20	2/22/2017
	8.37	8.85	0.48	0.30	3/28/2017**
	8.31	8.33	0.02	-	4/11/2017
	-	8.64	0.00	0.1 (from sock)	5/15/2017
	8.90	8.92	0.02	-	5/23/2017
	Sheen	9.15	0.00	0.00	6/20/2017
	Sheen	9.60	0.00	0.00	8/24/2017
	9.56	9.65	0.09	0.2 (from sock)	9/12/2017
	-	9.56	0.00	0.1 (from sock)	10/17/2017
		Removed Absorbant Sock			10/24/2017
	Sheen	9.58	Sheen	0	10/31/2017
		Placed Absorbant Sock			10/31/2018
		Checked sock - No NAPL			11/14/2017
		Checked and adjusted sock - No NAPL			12/5/2017
	8.58	8.71	0.13	0.1 (from sock)	4/24/2018
	Sheen	8.60	Sheen	0.00	5/1/2018
	0.00	8.80	Oil on probe	0.00	5/8/2018
	0.00	9.05	Oil on probe	0.00	5/29/2018
	-	9.27	Oil on Sock	<0.1 on sock	6/27/2018
	9.46	9.48	0.02	0.00	7/13/2018
	Unable to get accurate reading		Sheen	0.1 (from sock)	8/16/2018
	9.4	9.41	0.01	0.00	10/16/2018
	-	8.56	Sheen (on gauge)	0.00	12/4/2018
	8.90	9.80	0.90	0.5 (with sock)	3/5/2019
	8.85	8.86	0.01	0.00	3/12/2019
	-	8.95	0.00	0.00	3/26/2019
	Sheen	8.95	0.00	0.00	4/18/2019
	Sheen	8.33	0.00	0.00	4/23/2019
	Sheen	8.61	0.00	0.00	4/30/2019
	9.27	9.35	0.08	0.00	8/7/2019

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
	-	8.34	0.00	0.00	7/11/2005
	-	8.29	0.00	0.00	7/29/2005
	-	8.21	0.00	0.00	8/16/2005
	-	8.16	0.00	0.00	3/7/2006
	-	8.84	0.00	0.00	11/7/2007
	-	9.80	0.00	0.00	9/10/2009
B-30MW	-	6.00	0.00	0.00	4/2/2010
	-	8.34	0.00	0.00	6/24/2011
	-	8.52	0.00	0.00	4/17/2012
	-	8.55	0.00	0.00	8/29/2012
	-	7.69	0.00	0.00	2/23/2017
	-	8.51	0.00	0.00	10/17/2017
	-	8.53	0.00	0.00	8/16/2018
	-	8.50	0.00	0.00	12/4/2018
	12.02	12.39	0.37	2.00	7/11/2005
	12.47	12.59	0.12	0.50	7/15/2005
	12.56	12.72	0.16	0.50	7/20/2005
	13.65	13.73	0.08	0.50	7/22/2005
	12.71	12.72	0.01	0.00	7/29/2005
	-	12.58	0.00	0.00	8/16/2005
	12.46	12.51	0.05	0.00	3/7/2006
	-	12.94	0.00	0.00	8/31/2006
	-	10.36	0.00	0.00	3/28/2007
	-	9.64	0.00	0.00	4/18/2007
	-	12.14	0.00	0.00	6/7/2007
	-	11.03	0.00	0.00	7/12/2007
	-	12.92	0.00	0.00	8/14/2007
	-	13.23	0.00	0.00	9/20/2007
	-	13.13	0.00	0.00	10/11/2007
	-	13.16	0.00	0.00	10/18/2007
	-	13.13	0.00	0.00	10/25/2007
	-	13.21	0.00	0.00	11/2/2007
	-	13.54	0.00	0.00	11/7/2007
	-	13.21	0.00	0.00	11/8/2007
	-	13.22	0.00	0.00	11/28/2007
B-31/MW	-	13.26	0.00	0.00	12/6/2007
	-	11.44	0.00	0.00	4/2/2008
	-	9.95	0.00	0.00	8/14/2008
	-	9.88	0.00	0.00	8/27/2008
	-	9.93	0.00	0.00	9/18/2008
	-	12.01	0.00	0.00	9/10/2009
	-	9.35	0.00	0.00	4/2/2010
	-	probe stuck			6/24/2011
	-	probe stuck			4/18/2012
	-	12.90	0.00	0.00	5/20/2014
	11.94	11.95	0.01	0.00	4/23/2015
	-	12.84	0.00	0.00	7/30/2015
	-	12.39	0.00	0.00	12/15/2015
	-	12.74	0.00	0.00	12/8/2016
	Sheen	12.00	0.00	0.00	2/23/2017
		Bottom of well at 12.55'			10/17/2017
	-	12.10	0.00	0.00	5/8/2018
	-	12.32	0.00	0.00	5/29/2018
	-	12.51	0.00	0.00	6/27/2018
	-	12.44	0.00	0.00	10/16/2018
	-	11.42	0.00	0.00	12/4/2018
	-	12.65	0.00	0.00	8/6/2019

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
B-35R/MW	-	9.90	0.00	0.00	3/5/2019
	9.60 (placed sock)	9.80	0.20	0.00	4/30/2019
	-	10.22	0.00	0.00	8/6/2019
B-36/MW	-	10.25	0.00	0.00	8/29/2012
B-37MW	8.82	9.88	1.06	3.00	7/11/2005
	9.09	9.74	0.65	1.00	7/15/2005
	9.26	9.81	0.55	0.50	7/22/2005
	9.37	9.59	0.22	0.50	7/29/2005
	9.35	9.60	0.25	0.00	8/16/2005
	9.25	9.98	0.73	0.00	3/7/2006
	10.02	10.46	0.44	0.13	10/18/2006
	10.03	10.28	0.25	0.25	10/23/2006
	-	-	-	0.50	11/15/2006
	-	-	-	0.50	12/20/2006
	-	-	-	0.15	1/11/2007
	-	-	-	0.50	2/7/2007
	-	8.76	0.00	0.00	4/18/2007
	-	9.62	0.00	0.00	6/7/2007
	-	9.99	0.00	0.00	7/12/2007
	-	10.18	0.00	0.00	8/14/2007**
	10.12	10.13	0.01	0.13	9/12/2007
	-	10.36	0.00	0.06	9/20/2007
	-	-	-	0.08	9/26/2007
	-	9.37	0.00	0.25	10/3/2007
	-	10.35	0.00	0.06	10/11/2007**
	-	10.33	0.00	0.00	10/25/2007
	-	9.42	0.00	0.00	11/2/2007
	-	10.31	0.00	0.00	11/8/2007
	13.98	13.99	0.00	0.06	12/12/2007**
	-	10.07	0.00	0.00	12/26/2007
	9.92	9.98	0.06	0.03	1/24/2008**
	9.31	9.45	0.15	0.15	8/14/2008
	9.58	9.62	0.04	0.04	8/27/2008
	-	9.67	0.00	0.00	9/18/2008
	9.12	9.32	0.20	0.20	10/2/2008
	7.6	7.79	0.19	0.00	4/2/2010
	9.51	10.30	0.79	0.33	5/18/2010
	9.65	9.90	0.25	0.00	6/4/2010
	9.62	10.40	0.78	0.25	6/15/2010
	9.73	9.87	0.14	0.10	9/30/2010
	9.69	9.85	0.16	0.20	10/27/2010
	9.68	9.79	0.11	0.05	11/16/2010
	9.18	9.60	0.42	0.25	4/25/2011
	9.44	9.50	0.06	0.1 (from sock)	6/24/2011
	9.7	9.90	0.20	0.00	7/11/2011
	8	?	?	0.00	10/11/2011***
	8.97	?	?	0.00	11/29/2011***
	8.94	8.98	0.04	0.05	12/26/2011
	8.89	9.10	0.21	0.02	12/23/2011
		clogged at 9.45' (oil on probe)			4/17/2012
		clogged at 9.50' (oil on probe)			5/21/2013
		clogged at 9.40'			9/5/2013
	9.3	Bot at 9.55	0.25	Placed sock	5/20/2014
	9.43	9.47	0.04	Replaced sock	9/30/2014
	Clogged - Replaced with B-37R immediately adjacent to location of B-37				

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
B-37R/MW	-	9.73	0.00	0.00	9/30/2014
	-	9.4	0.00	0.00	1/21/2015
	-	9.01	0.00	0.00	4/23/2015
	-	9.6	0.00	0.00	7/30/2015
	-	9.38	0.00	0.00	12/15/2015
	-	9.42	0.00	0.00	12/8/2016
	-	8.90	0.00	0.00	2/22/2017
	-	8.93	0.00	0.00	3/28/2017
	-	8.38	0.00	0.00	4/11/2017
	-	8.82	0.00	0.00	5/16/2017
	-	9.00	0.00	0.00	5/23/2017
	-	8.90	0.00	0.00	6/20/2017
	-	9.55	0.00	0.00	9/12/2017
	-	9.59	0.00	0.00	8/16/2018
	-	8.78	0.00	0.00	12/4/2018
	-	9.14	0.00	0.00	4/18/2019
	-	8.50	0.00	0.00	4/23/2019
	-	8.80	0.00	0.00	4/30/2019
B-38MW	9.43	10.04	0.61	3.75	7/11/2005
	9.72	10.06	0.34	2.00	7/15/2005
	9.81	10.03	0.22	0.50	7/20/2005
	9.84	10.06	0.22	0.50	7/22/2005
	9.94	10.11	0.17	0.00	7/29/2005
	9.90	10.22	0.32	0.00	8/16/2005
	9.90	10.15	0.25	0.00	3/7/2006
				0.10	7/13/2006**
	9.91	9.95	0.04	0.00	8/31/2006
	9.26	9.58	0.32	0.33	11/1/2006
	-	-	-	0.25	12/20/2006
	9.63	9.71	0.08	0.33	3/28/2007
	-	8.84	0.00	0.00	4/18/2007
	-	10.71	0.00	0.00	6/7/2007
	10.04	10.05	0.01	0.00	7/12/2007
	-	10.28	0.00	0.00	8/14/2007
	-	10.31	0.00	0.06	9/12/2007
	-	10.46	0.00	0.06	9/20/2007
	-	-	-	0.08	9/26/2007
	-	10.43	0.00	0.00	10/11/07**
	-	10.42	0.00	0.00	10/25/2007
	-	10.51	0.00	0.00	11/2/2007
	-	10.38	0.00	0.00	11/8/2007
	-	10.47	0.00	0.00	11/28/2007
	-	10.49	0.00	0.00	12/6/2007
	-	10.47	0.00	0.06	12/12/2007
	-	9.41	0.00	0.00	3/7/2008
	-	Dry at 7.28	0.00	0.00	8/14/2008
	-	Dry at 7.28	0.00	0.00	8/27/2008
	-	Dry at 7.28	0.00	0.00	9/18/2008
	-	Dry at 7.28	0.00	0.00	9/10/2009
	-	Dry at 7.28	0.00	0.00	4/2/2010
	10.02	10.03	0.01	0.00	6/24/2011
	-	10.25	0.00	0.00	7/11/2011
	9.60	?	?	0.00	10/11/2011***
	9.70	9.73	0.03	0.00	11/29/2011
	9.57	9.60	0.03	0.02	12/16/2011
	9.44	9.45	0.01	0.01	12/23/2011
	-	10.90	0.00	0.00	8/29/2012
		Dry at 7.20			5/20/2014
	9.54	9.80	0.26	0.05	4/23/2015
	-	10.22	0.00	0.00	7/30/2015
	-	9.96	0.00	0.00	12/15/2015
	-	9.98	0.00	0.00	12/8/2016
	-	9.12	0.00	0.00	2/23/2017
	-	9.49	0.00	0.00	3/28/2017
	9.95	9.96	0.01	0.00	4/11/2017
	9.36	9.40	0.04	0.00	5/16/2017**
	9.55	9.57	0.02	0.00	5/23/2017
	Sheen	9.53	0.00	0.00	6/20/2017
	-	9.89	0.00	0.00	8/24/2017
	-	10.10	0.00	0.00	9/12/2017
		Removed Sock			10/24/2017
	8.61	8.64	0.03	0	10/31/2017
		Placed Absorbant Sock			10/31/2018
		Checked sock - No NAPL			11/14/2017
		Checked and adjusted sock - No NAPL			12/5/2017
	9.36	9.38	0.02	0.00	4/24/2018
	Sheen	9.35	Sheen	0.00	5/1/2018
	-	9.55	0.00	0.00	5/8/2018
	-	9.80	0.00	0.00	5/29/2018
	-	10.00	Some Oil on sock	<0.01	6/27/2018
	-	10.22	0.00	0.00	7/13/2018
	-	10.16	0.00	0.00	10/16/2018
	9.28	9.30	0.02	No sock - replaced	12/4/2018
	-	9.75	0.00	0.00	3/26/2019
	-	9.80	0.00	0.00	4/18/2019
	-	9.20	0.00	0.00	4/23/2019
	-	9.46	0.00	0.00	4/30/2019
	10.01	10.04	0.04	0.00	8/6/2019
	-	10.03	0.00	0.00	8/7/2019

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
B-39MW	-	10.88	0.00	0.00	7/11/2005
	-	11.11	0.00	0.00	7/15/2005
	-	11.27	0.00	0.00	7/22/2005
	-	11.31	0.00	0.00	7/29/2005
	-	9.69	0.00	0.00	8/16/2005
	-	10.35	0.00	0.00	3/7/2006
	-	10.21	0.00	0.00	4/18/2007
	-	10.12	0.00	0.00	6/7/2007
	-	10.61	0.00	0.00	7/12/2007
	-	10.76	0.00	0.00	8/14/2007
	-	11.11	0.00	0.00	10/11/07**
	-	11.09	0.00	0.00	10/18/2007
	-	11.01	0.00	0.00	10/25/2007
	-	11.08	0.00	0.00	11/2/2007
	-	10.84	0.00	0.00	11/8/2007
	-	11.17	0.00	0.00	11/28/2007
	-	11.50	0.00	0.00	12/6/2007
	11.53	11.54	0.00	0.06	12/12/2007
	-	11.76	0.00	0.00	1/7/2008
	-	11.02	0.00	0.00	3/7/2008
	-	11.20	0.00	0.00	4/2/2008
	-	11.45	0.00	0.00	9/10/2009
	-	8.49	0.00	0.00	4/2/2010
	-	11.30	0.00	0.00	6/24/2011
	-	11.15	0.00	0.00	1/13/2012
	-	11.92	0.00	0.00	8/29/2012
	-	11.45	0.00	0.00	5/20/2014
	-	10.98	0.00	0.00	4/23/2015
	-	11.39	0.00	0.00	12/8/2016
	-	10.94	0.00	0.00	5/8/2018
	-	11.20	0.00	0.00	5/29/2018
	-	11.42	0.00	0.00	6/27/2018
	-	11.19	0.00	0.00	8/16/2018
	-	11.55	0.00	0.00	10/16/2018
B-40 RW	5.71	5.77	0.06	0.00	7/15/2005
	5.87	6.02	0.15	0.00	7/22/2005
	5.91	6.06	0.15	0.50	7/29/2005
	5.85	5.93	0.08	0.00	8/16/2005
	-	4.55	0.00	0.00	3/7/2006
	4.52	4.58	0.06	0.00	6/30/2006
	-	5.81	0.00	0.00	8/31/2006
	5.39	5.57	0.18	0.00	3/28/2007
	4.47	4.53	0.06	0.00	4/18/2007
	-	5.82	0.00	0.00	6/7/2007
	-	10.61	0.00	0.00	7/12/2007
	6.60	6.62	0.02	0.00	8/14/2007
	-	6.49	0.00	0.00	9/12/2007
	6.86	6.91	0.05	0.50	9/20/2007
	-	-	-	0.75	9/26/2007
	6.86	6.88	0.02	2.00	10/3/2007
	6.85	6.97	0.12	1.50	10/11/2007
	6.90	7.02	0.12	0.33	10/18/2007
	6.81	6.92	0.11	3.00	10/25/2007
	6.91	6.93	0.02	0.75	11/2/2007
	6.83	6.89	0.06	0.50	11/8/2007
	6.89	6.95	0.06	0.25	11/28/2007
	6.93	7.01	0.08	0.13	12/6/2007
	-	6.91	0.00	0.00	12/12/2007
	6.58	6.70	0.12	0.50	12/26/2007
	6.58	6.63	0.05	0.06	1/7/2008 **
	-	6.44	0.00	0.25	1/17/2008
	-	6.61	0.00	0.00	1/24/2008
	-	5.17	0.00	0.03	2/14/2008
	-	5.57	0.00	0.00	2/28/2008
	-	5.71	0.00	0.00	3/7/2008
	-	5.76	0.00	0.00	3/26/2008
	-	5.64	0.00	0.00	8/27/2008
	-	6.03	sheen	0.00	9/18/2008
	4.66	4.70	0.04	0.04	10/2/2008
	6.10	8.10	2.00	0.04	8/21/2009***
	6.20	6.40	0.20	0.15	9/10/2009
	6.15	6.26	0.09	0.15	9/24/2009
	6.17	6.28	0.11	0.15	9/30/2009
	6.05	6.07	0.02	0.05	10/7/2009
	6.18	6.19	0.01	0.00	10/14/2009
	-	6.73	0.00	0.00	12/3/2009
	5.63	5.64	0.01	0.05	12/11/2009
	5.84	5.85	0.01	0.05	12/18/2009
	5.91	6.02	0.03	0.30	1/20/2010
	5.77	5.81	0.04	0.25 (w/ sock)	2/2/2010
	4.15	4.16	0.01	0.05 (w/ sock)	3/24/2010
	4.40	4.41	0.01	0.1 (w/sock)	4/8/2010
	6.07	6.08	0.01	0.00	5/18/2010
	6.25	6.26	0.01	0.00	6/4/2010
	6.32	6.35	0.03	0.05	6/15/2010
	6.04	6.06	0.02	0.00	8/24/2010
	-	6.27	0.00	0.00	9/30/2010
	6.23	6.24	0.01	0.00	10/27/2010
	-	6.07	0.00	0.00	11/16/2010
	6.20	6.21	0.01	0.00	1/13/2011
	6.06	6.07	0.01	0.00	1/25/2011
	4.86	4.95	0.09	0.00	3/11/2011
	5.41	5.47	0.05	0.05	3/24/2011
	-	5.65	0.00	0.00	4/4/2011
	-	5.94	0.00	0.00	6/24/2011
	-	6.34	0.00	0.00	7/11/2011
	5.50	5.60	0.10	0.00	10/11/2011***
	5.50	5.51	0.01	0.00	11/29/2011
	5.24	5.25	0.01	0.01	12/16/2011
	-	5.47	0.00	0.00	12/23/2011
	-	6.03	0.00	0.00	4/18/2012
	-	6.05	0.00	0.00	8/29/2012
	-	5.45	0.00	0.00	6/11/2013
	-	5.5 (Dry)	-	-	9/5/2013
		Plugged with ORC			5/20/2014
		Plugged with ORC			12/6/2016

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
B-41MW	-	6.07	0.00	0.00	3/7/2006
	-	5.57	0.00	0.00	6/24/2011
IW-2	5.27	5.57	0.30	0.20	2/24/2010
	4.42	5.17	0.75	0.15	3/24/2010
	5.04	5.93	0.89	0.20	4/8/2010
	5.32	5.84	0.52	0.25	4/12/2010
	5.99	8.19	2.20	0.15	5/14/10***
	6.25	6.89	0.64	0.00	6/4/2010
	6.25	6.82	0.57	0.05	6/15/2010
	-	6.24	0.00	0.00	8/24/2010
	6.48	6.50	0.02	0.00	9/30/2010
	6.35	6.36	0.01	0.00	10/27/2010
	6.40	6.48	0.08	0.00	11/16/2010
	6.40	6.44	0.40	0.00	1/13/2011
	6.35	6.40	0.05	0.00	1/25/2011
	6.26	6.35	0.09	0.00	2/10/2011
	-	5.04	0.00	0.00	3/11/2011
	-	5.31	0.00	0.00	3/24/2011
	-	5.79	0.00	0.00	4/4/2011
	-	6.00	0.00	0.00	5/4/2011
	-	6.42	0.00	0.00	7/11/2011
	-	5.95	0.00	0.00	10/11/2011
	5.62	5.63	0.01	0.00	11/29/2011
	5.47	5.48	0.01	0.01	12/16/2011
	5.37	5.38	0.01	0.00	12/23/2011
	5.87	5.88	0.01	0.00	1/13/2012
	-	6.35	0.00	0.00	4/18/2012
	-	6.40	0.00	0.00	8/29/2012
	-	8.08	0.00	0.00	1/15/2013
	-	5.60	0.00	0.00	6/11/2013
	-	6.44	0.00	0.00	9/5/2013
	6.32	6.35	0.03	0.01	5/20/2014
		Plugged at 6.14 feet			9/30/2014
		Plugged at 6.00 feet			2/19/2015
	-	7.55	0.00	0.00	4/23/2015
	-	5.72	0.00	0.00	12/6/2016
	-	5.57	0.00	0.00	2/22/2017
		Botton of well at 6.19			10/12/2017
		Botton of well at 6.19			8/16/2018
	-	5.80	0.00	0.00	8/7/2019
IW-3	-	5.29	0.00	0.00	2/24/2010
	4.51	4.52	0.01	0.05	3/24/2010
	5.10	5.12	0.02	0.00	4/8/2010
	6.30	6.31	0.01	0.00	6/4/2010
	6.29	6.31	0.02	0.00	6/15/2010
	6.22	6.23	0.01	0.00	8/24/2010
	6.45	6.50	0.05	0.00	10/27/2010
	6.45	6.47	0.02	0.00	11/16/2010
	6.41	6.44	0.03	0.00	1/13/2011
	6.38	6.40	0.02	0.00	1/25/2011
	6.28	6.29	0.01	0.00	2/10/2011
	-	5.10	0.00	0.00	3/11/2011
	5.68	5.69	0.01	0.00	3/24/2011
	5.94	6.01	0.07	0.01	4/4/2011
	6.08	6.25	0.17	0.05	5/4/2011
	6.15	6.60	0.45	0.00	6/24/2011
	6.30	7.09	0.79	0.00	7/11/2011
	6.30	6.40	0.10	0.00	10/11/2011***
	5.82	5.63	0.01	0.00	11/29/2011
	-	5.60	0.00	0.00	12/16/2011
	5.50	5.51	0.01	0.01	12/23/2011
	-	6.19	0.00	0.00	4/18/2012
	6.15	6.80	0.65	0.20	8/29/2012
	5.40	5.43	0.03	0.01	6/11/2013
	6.71	6.73	0.02	0.01	9/5/2014
	-	6.08	0.00	0.00	5/20/2014
	6.36	6.35	0.01	0.01	9/30/2014
	-	6.30	0.00	0.00	2/19/2015
	-	8.30	0.00	0.00	7/30/2015
	-	5.89	0.00	0.00	12/31/2015
	-	6.08	0.00	0.00	12/6/2016
	-	5.58	0.00	0.00	2/22/2017
	-	6.25	0.00	0.00	10/12/2017
	-	5.17	0.00	0.00	5/1/2018
		Inaccessible			8/16/2018
	-	6.10	0.00	0.00	8/7/2019
IW-5	6.30	6.32	0.02	0.05	1/14/2010
	5.35	5.59	0.24	0.15	2/24/2010
	4.90	5.24	0.34	0.10	3/24/2010
	5.09	5.94	0.85	0.05	4/8/2010
	5.42	5.68	0.26	0.00	4/12/2010
	6.22	6.45	0.23	0.05	5/14/2010
	6.34	6.42	0.08	0.00	6/4/2010
	6.33	6.40	0.07	0.00	6/15/2010
	-	6.29	0.00	0.00	8/24/2010
	6.45	6.88	0.43	0.05	10/27/2010
	6.49	6.59	0.10	0.00	11/16/2010
	6.45	6.70	0.15	0.05	1/13/2011
	6.40	6.41	0.01	0.00	1/25/2011
	-	5.31	0.00	0.00	3/24/2011
	-	4.88	0.00	0.00	3/11/2011
	-	5.68	0.00	0.00	4/4/2011
	-	5.85	0.00	0.00	5/4/2011
	6.40	6.80	0.40	0.00	7/11/2011
	6.00	6.30	0.30	0.00	10/11/2011
	5.50	5.70	0.20	0.00	11/29/2011
	5.43	5.60	0.17	0.01	12/16/2011
	4.49	4.50	0.01	0.01	12/23/2011
	5.92	5.94	0.02	0.00	1/13/2012
	-	5.98	0.00	0.00	2/2/2012
	-	6.36	0.00	0.00	4/18/2012
	6.35	7.00	0.65	0.10	8/29/2012
	5.48	5.72	0.24	0.05	1/15/2013
	5.55	7.25	1.70	0.20	6/11/2013
	6.37	6.52	0.15	0.02	9/5/2014
	6.05	6.06	0.01	0.01	5/20/2014
	-	6.56	0.00	0.00	9/30/2014
	-	6.48	0.00	0.00	2/19/2015
	-	5.65	0.00	0.00	4/23/2015
		Plugged/Dry 6.2 feet			7/30/2015
	-	5.94	0.00	0.00	12/31/2015
	-	6.22	0.00	0.00	12/6/2016
	-	5.63	0.00	0.00	2/22/2017
	Sheen	6.32	0.00	0.00	10/12/2017
	-				
	-	5.63	0.00	0.00	5/1/2018
	-	5.71	0.00	0.00	8/16/2018
	-	Dry	0.00	0.00	8/7/2019

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
IW-6	-	6.28	0.00	0.00	1/14/2010
	5.38	5.39	0.01	0.01	2/24/2010
	-	4.57	0.00	0.00	3/24/2010
	-	5.19	0.00	0.00	4/8/2010
	-	5.44	0.00	0.00	4/12/2010
	-	6.27	0.00	0.00	5/14/2010
	-	6.36	0.00	0.00	6/4/2010
	-	6.36	0.00	0.00	6/15/2010
	-	6.32	0.00	0.00	8/24/2010
	-	6.51	0.00	0.00	10/27/2010
	-	6.50	0.00	0.00	11/16/2010
	-	6.51	0.00	0.00	1/13/2011
	-	6.49	0.00	0.00	1/25/2011
	-	5.05	0.00	0.00	3/11/2011
	5.63	5.64	0.01	0.00	3/24/2011
	5.86	5.88	0.20	0.00	4/4/2011
	-	6.47	0.00	0.00	7/11/2011
	-	5.90	0.00	0.00	10/11/2011
	-	5.73	0.00	0.00	11/29/2011
	-	5.61	0.00	0.00	12/16/2011
	-	5.57	0.00	0.00	12/23/2011
	-	6.45	0.00	0.00	4/18/2012
	-	6.50	0.00	0.00	8/29/2012
	-	7.88	0.00	0.00	1/15/2013
	-	5.70	0.00	0.00	6/11/2013
	6.19	6.23	0.04	0.01	5/20/2014
	6.50	6.64	0.14	0.02	9/30/2014
	-	6.45	0.00	0.00	2/19/2015
	Removed and replaced with IW-6R on 2/19/15				
IW-6R	-	5.67	0.00	0.00	3/14/2015
	-	5.57	0.00	0.00	4/23/2015
	-	9.32	0.00	0.00	7/30/2015
	-	5.95	0.00	0.00	12/31/2015
	-	6.07	0.00	0.00	12/6/2016
	-	5.44	0.00	0.00	2/22/2017
	-	6.27	0.00	0.00	10/12/2017
	-	5.18	0.00	0.00	5/1/2018
	-	5.18	0.00	0.00	5/1/2018
	-	6.32	0.00	0.00	7/13/2018
	-	6.28	0.00	0.00	8/16/2018
	-	6.09	0.00	0.00	8/7/2019
IW-7	-	6.42	0.00	0.00	1/14/2010
	-	5.42	0.00	0.00	2/24/2010
	-	4.60	0.00	0.00	3/24/2010
	-	5.04	0.00	0.00	4/8/2010
	-	6.41	0.00	0.00	6/4/2010
	-	6.42	0.00	0.00	6/15/2010
	-	6.56	0.00	0.00	11/16/2010
	-	6.51	0.00	0.00	1/13/2011
	-	6.47	0.00	0.00	1/25/2011
	-	6.40	0.00	0.00	2/10/2011
	-	4.54	0.00	0.00	3/11/2011
	-	4.92	0.00	0.00	3/24/2011
	-	5.23	0.00	0.00	4/4/2011
	-	6.23	0.00	0.00	6/24/2011
	-	6.42	0.00	0.00	4/18/2012
	-	6.45	0.00	0.00	8/29/2012
	-	4.99	0.00	0.00	1/15/2013
	-	5.58	0.00	0.00	6/11/2013
	-	5.30	0.00	0.00	5/20/2014
	-	6.55	0.00	0.00	9/30/2014
	Sheen	5.21	0.00	0.00	3/14/2015
	-	5.20	0.00	0.00	4/23/2015
	-	6.41	0.00	0.00	7/30/2015
	-	6.09	0.00	0.00	1/5/2016
	-	6.15	0.00	0.00	12/6/2016
	-	5.58	0.00	0.00	2/23/2017
	-	5.67	0.00	0.00	3/28/2017
	-	6.39	0.00	0.00	10/12/2017
	-	6.20	0.00	0.00	8/7/2019
IW-8	-	6.41	0.00	0.00	1/14/2010
	-	5.43	0.00	0.00	2/24/2010
	-	3.72	0.00	0.00	3/24/2010
	-	4.17	0.00	0.00	4/8/2010
	-	6.04	0.00	0.00	6/4/2010
	6.15	6.16	0.01	0.00	6/15/2010
	-	6.35	0.00	0.00	8/24/2010
	-	5.77	0.00	0.00	11/16/2010
	-	5.73	0.00	0.00	1/13/2011
	-	5.56	0.00	0.00	1/25/2011
	-	5.55	0.00	0.00	2/10/2011
	-	3.45	0.00	0.00	3/11/2011
	-	5.52	0.00	0.00	3/24/2011
	-	5.55	0.00	0.00	4/4/2011
	-	5.20	0.00	0.00	6/24/2011
	sheen	6.05	0.00	0.00	7/11/2011
	-	5.75	0.00	0.00	8/29/2012
	-	5.26	0.00	0.00	1/15/2013
	-	4.55	0.00	0.00	6/11/2013
	-	5.33	0.00	0.00	5/20/2014
	-	6.50	0.00	0.00	9/30/2014
	-	5.90	0.00	0.00	2/19/2015
	-	5.85	0.00	0.00	7/30/2015
	-	5.52	0.00	0.00	1/5/2016
	-	6.22	0.00	0.00	12/6/2016
	-	5.29	0.00	0.00	2/23/2017
	-	6.31	0.00	0.00	10/12/2017
	-	4.96	0.00	0.00	5/1/2018
		6.24	0.00	0.00	8/16/2018
	-	5.60	0.00	0.00	8/6/2019

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
IW-9	-	5.31	0.00	0.00	2/24/2010
	4.22	7.37	3.15	0.30	3/24/2010**
	4.88	5.66	0.78	0.25	4/8/2010
	5.40	5.90	0.50	0.15	4/12/2010
	6.26	6.41	0.15	0.01	5/14/2010
	6.35	6.36	0.01	0.00	6/4/2010
	6.35	6.35	0.02	0.00	6/15/2010
	-	6.29	0.00	0.00	8/24/2010
	-	6.50	0.00	0.00	10/27/2010
	-	6.48	0.00	0.00	11/16/2010
	-	6.44	0.00	0.00	1/13/2011
	-	6.38	0.00	0.00	1/25/2011
	-	6.30	0.00	0.00	2/10/2011
	-	5.03	0.00	0.00	3/11/2011
	-	5.83	0.00	0.00	3/24/2011
	-	5.92	0.00	0.00	4/4/2011
	-	6.20	0.00	0.00	6/24/2011
	6.00	6.10	0.10	0.00	10/11/2011
	5.80	5.95	0.15	0.00	11/29/2011
	5.70	5.71	0.01	0.01	12/16/2011
	5.66	5.67	0.01	0.01	12/23/2011
	-	6.33	0.00	0.00	4/18/2012
	-	6.40	0.00	0.00	8/29/2012
	-	5.72	0.00	0.00	1/15/2013
	-	5.40	0.00	0.00	6/11/2013
	-	6.10	0.00	0.00	5/20/2014
	-	6.25	0.00	0.00	2/19/2015
		PLUGGED AT 5.90'			7/30/2015
		Dry at 6.20			1/5/2016
	-	6.12	0.00	0.00	12/6/2016
	-	5.58	0.00	0.00	2/23/2017
	-	5.72	0.00	0.00	8/16/2018
IW-11	-	9.52	0.00	0.00	1/14/2010
	-	5.75	0.00	0.00	4/2/2010
	-	7.62	0.00	0.00	4/12/2010
	-	9.71	0.00	0.00	6/15/2010
	-	9.71	0.00	0.00	9/30/2010
	-	9.72	0.00	0.00	10/27/2010
	-	9.72	0.00	0.00	11/16/2010
	-	9.23	0.00	0.00	4/25/2011
	-	9.40	0.00	0.00	6/24/2011
	-	9.55	0.00	0.00	4/17/2012
	-	9.20	0.00	0.00	8/29/2012
	-	9.60	0.00	0.00	5/21/2013
LB-51/MW	-	9.47	0.00	0.00	9/30/2014
	-	9.15	0.00	0.00	1/21/2015
	-	8.76	0.00	0.00	4/23/2015
	-	9.35	0.00	0.00	7/30/2015
	-	9.13	0.00	0.00	12/31/2015
	-	9.15	0.00	0.00	12/8/2016
	-	8.63	0.00	0.00	2/22/2017
	-	8.69	0.00	0.00	3/28/2017
	-	8.16	0.00	0.00	4/11/2017
	-	8.56	0.00	0.00	5/16/2017
	-	8.79	0.00	0.00	5/23/2017
	-	8.63	0.00	0.00	6/20/2017
	-	9.51	0.00	0.00	8/24/2017
	-	9.29	0.00	0.00	9/12/2017
	-	9.33	0.00	0.00	10/17/2017
	-	9.00	0.00	0.00	5/8/2018
	-	9.25	0.00	0.00	5/29/2018
	-	9.25	0.00	0.00	6/27/2018
	-	9.66	0.00	0.00	10/16/2018
	-	8.51	0.00	0.00	12/4/2018
		9.22	0.00	0.00	8/7/2019
LB-52/MW	-	6.88	0.00	0.00	9/30/2014
	-	6.50	0.00	0.00	1/21/2015
	-	5.98	0.00	0.00	4/23/2015
LB-53/MW	-	9.58	0.00	0.00	9/30/2014
	-	9.17	0.00	0.00	1/21/2015
	-	8.79	0.00	0.00	4/23/2015
	-	9.40	0.00	0.00	7/30/2015
	-	9.19	0.00	0.00	12/15/2015
	-	9.22	0.00	0.00	12/8/2016
	-	8.73	0.00	0.00	2/22/2017
	-	8.73	0.00	0.00	3/28/2017
	-	8.15	0.00	0.00	4/11/2017
	-	8.60	0.00	0.00	5/16/2017
	-	8.60	0.00	0.00	5/31/2017
	-	8.70	0.00	0.00	6/20/2017
	-	9.39	0.00	0.00	9/12/2017
	-	9.43	0.00	0.00	10/17/2017
	-	8.80	0.00	0.00	5/8/2018
	-	9.05	0.00	0.00	5/29/2018
	-	9.65	0.00	0.00	6/27/2018
	-	9.44	0.00	0.00	8/16/2018
	-	9.40	0.00	0.00	10/16/2018
	-	8.42	0.00	0.00	12/4/2018
	-	9.04	0.00	0.00	3/5/2019
	-	8.96	0.00	0.00	4/18/2019
	-	8.36	0.00	0.00	4/23/2019
	-	8.6	0.00	0.00	4/30/2019
	-	9.33	0.00	0.00	8/6/2019

Table 1. Gauging and Bailing Data
Horace Mann School
687 Watertown Street
Newton, MA

WELL ID	Depth to Product	Depth to Water	Product Thickness (ft)	LNAPL Bailed (L)	DATE
LB-54/MW	-	5.70	0.00	0.00	3/14/2015
	-	7.65	0.00	0.00	4/23/2015
	-	5.89	0.00	0.00	12/31/2015
	-	6.00	0.00	0.00	12/6/2016
	-	5.50	0.00	0.00	2/22/2017
	-	6.21	0.00	0.00	10/17/2017
	-	6.05	0.00	0.00	8/7/2019
LB-55/MW	-	7.85	0.00	0.00	8/6/2019
LB-61/MW	-	8.92	0.00	0.00	4/19/2019
	-	8.27	0.00	0.00	4/23/2019
	-	8.58	0.00	0.00	4/30/2019
	-	9.26	0.00	0.00	8/7/2019
LB-62/MW	Sheen	9	0.00	0.00	4/19/2019
	-	8.38	0.00	0.00	4/23/2019
	-	8.65	0.00	0.00	4/30/2019
LB-63/MW	-	8.72	0.00	0.00	4/19/2019
	-	8.12	0.00	0.00	4/23/2019
	-	8.65	0.00	0.00	4/30/2019
LB-64/MW	-	8.85	0.00	0.00	4/19/2019
	-	8.25	0.00	0.00	4/23/2019
	-	8.50	0.00	0.00	4/30/2019
	-	9.17	0.00	0.00	8/7/2019

NOTES
-: No product encountered
* P-8/MW--Not accessible to be gauged; under gym equipment
** Absorbent socks installed in well
*** Likely inaccurate reading due to measuring product in micro well

Table 2. GW EPH Data
All data in µg/L (micrograms per liter)
Horace Mann School, 687 Watertown Street, Newton

Well	GW Category	Naphthalene	2-Methylnaphthalene	Acenaphthene	Phenanthrene	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Date Well Sampled/Gauged
B-12/MW	GW-3	BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	8/29/2012
B-14/MW	GW-2/3	BRL - 10	BRL - 10	BRL - 10	BRL - 10	BRL - 100	BRL - 100	BRL - 100	6/24/2011
B-18/MW	GW-2/3	NT NT NT NT NT NT NT NT BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4 BRL-0.421 BRL-0.454 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT NT NT BRL - 10 BRL - 10 15.5 BRL-0.4 0.478 BRL-0.421 BRL-0.454 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT NT NT BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4 BRL-0.421 BRL-0.454 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT NT NT BRL - 10 BRL - 10 BRL - 10 2.75 BRL-0.4 BRL-0.421 BRL-0.454 BRL-0.4 BRL-0.4 BRL-0.4	2,050 2,070 258 4,460 BRL - 93.5 453 2,250 744 593 886 1,840 604 BRL - 100 BRL - 100 BRL - 100 208 248 127	1,310 2,140 305 5,780 BRL - 93.5 442 2,440 451 226 337 804 266 BRL - 100 BRL - 100 BRL - 100 121 215 391	1,450 3,040 414 4,860 BRL - 93.5 17,500 3,580 915 984 979 2,020 831 BRL - 100 BRL - 100 BRL - 100 123 164 430	11/19/2003 4/13/2004 11/3/2004 8/16/2005 4/18/2007 11/7/2007 4/2/2008 8/20/2009 6/24/2011 1/13/2012 4/18/2012 8/29/2012 4/23/2015 7/31/2015 12/15/2015 12/8/2016 2/23/2017 8/6/2019
B-19/MW	GW-2/3	NT NT	NT NT	NT NT	NT NT	234 216	174 341	258 552	12/30/2003 8/16/2005
B-20/MW	GW-2/3	BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4	0.525 BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4	BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4	BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4	BRL - 100 BRL - 100 BRL - 100 BRL - 100 BRL - 100	BRL - 100 BRL - 100 BRL - 100 BRL - 100 BRL - 100	BRL - 100 BRL - 100 BRL - 100 BRL - 100 BRL - 100	4/23/2015 7/31/2015 2/23/2017 10/17/2017 8/6/2019
B-21/MW	GW-3	NT NT NT NT NT NT NT	NT NT NT NT NT NT NT	NT NT NT NT NT NT NT	NT NT NT NT NT NT NT	BRL - 500 BRL - 100 BRL - 100 BRL - 100 BRL - 100 BRL - 100 ND	690 BRL - 100 BRL - 100 BRL - 100 BRL - 100 BRL - 100 ND	330 BRL - 100 BRL - 100 BRL - 100 BRL - 100 BRL - 100 ND	7/1/1998 3/29/2000 2/20/2001 4/18/2001 10/29/2001 2/15/2002 11/3/2004
B-22/MW	GW-3	NT NT NT NT NT NT NT NT BRL - 1.04 BRL - 10 BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4 BRL - 10 0.41 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT NT NT BRL - 1.04 BRL - 10 BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4 BRL - 10 2.06 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT NT NT BRL - 1.04 BRL - 10 BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4 BRL - 10 0.704 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT NT NT BRL - 1.04 BRL - 10 BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4 BRL - 10 1.41 BRL-0.4 BRL-0.4 0.612	7,210 477 299 3,220 169 BRL - 110 BRL - 102 BRL - 101 801 236 1,900 667 BRL - 100 207 140 BRL - 100 537 297 381 455	4,170 383 330 3,140 127 BRL - 110 BRL - 102 BRL - 101 756 156 1,430 819 BRL - 100 231 217 BRL - 100 573 563 1,160 1,100	2,610 620 492 3,730 339 259 115 116 1,640 260 2,320 999 262 348 198 BRL - 100 689 446 483 766	11/19/2003 4/13/2004 11/3/2004 8/16/2005 4/18/2007 11/7/2007 4/2/2008 8/20/2009 2/14/2011 6/24/2011 1/13/2012 4/16/2012 8/29/2012 4/23/2015 7/31/2015 12/15/2015 12/8/2016 2/22/2017 8/6/2019
B-26/MW	GW-3	19 39.7	19 79.8	2.92 10.9	14.4 29.6	**7,660** **9,160**	4,180 4,580	**5,520** **11,000**	7/31/2015 12/8/2016
B-30/MW	GW-3	NT NT NT BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4	NT NT NT BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4	NT NT NT BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4	NT NT NT BRL - 10 BRL - 10 BRL - 10 BRL-0.4 BRL-0.4	BRL - 100 168 BRL - 108 191 231 BRL - 100 BRL - 100 BRL - 100	BRL - 100 BRL - 100 BRL - 108 112 125 158 BRL - 100 BRL - 100	BRL - 100 BRL - 100 BRL - 108 174 195 216 BRL - 100 BRL - 100	11/3/2004 8/16/2005 11/7/2007 6/24/2011 4/16/2012 6/24/2011 2/23/2017
B-31/MW	GW-2/3	NT NT NT NT NT NT BRL - 1.1 BRL - 10 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT BRL - 1.1 BRL - 10 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT BRL - 1.1 BRL - 10 0.456 BRL-0.4 0.42	NT NT NT NT NT NT BRL - 1.1 BRL - 10 1/1/1900 BRL-0.4 0.828	31,000 2,590 BRL - 97.1 24,900 388 186 726 234 3,740 BRL - 100 651	26,800 2,710 BRL - 97.1 20,900 549 258 1,080 205 2,260 BRL - 100 434	28,100 2,960 BRL - 97.1 6,950 545 739 1,090 244 2,870 950 729	11/3/2004 8/16/2005 4/18/2007 11/7/2007 4/2/2008 8/20/2009 2/14/2011 6/24/2011 7/31/2015 12/8/2016 2/23/2017
B-35R/MW	GW-2/3	BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	8/6/2019
B-36/MW	GW-3	BRL - 2	16	BRL - 2	16	**8320**	4580	**11300**	8/29/2012
B-37R/MW	GW-3	BRL-0.4 BRL-0.421 BRL-0.4 BRL-0.4 0.498 BRL-0.4	1.19 0.867 BRL-0.4 1.27 3.11 1.29	BRL-0.4 0.421 BRL-0.4 0.882 0.864 0.562	0.864 1.1 3 0.518 1.88 BRL-0.4	288 795 1540 BRL - 100 809 172	BRL - 100 718 260 BRL - 100 587 152	373 1,080 1,050 313 937 326	4/23/2015 7/31/2015 12/15/2015 12/8/2016 2/22/2017 10/17/2017
B-38/MW	GW-3	BDL-0.4 BDL-0.4 BDL-0.4 2.20 2.83	8.56 0.75 2.38 0.99 BRL - 0.8	BDL-0.4 2.32 2 5.56 7.85	7.36 1.1 BDL-0.4 1/8/1900 1/20/1900	3,690 3,670 857 **8,030** **24,600**	2,230 2,350 240 5,130 14,900	6,990 2,950 756 10,700 20,300	8/29/2012 7/31/2015 12/15/2015 12/8/2016 2/23/2017
B-39/MW	GW-2/3	BRL-0.4 BRL-0.4	0.508 BRL-0.4	BRL-0.4 BRL-0.4	BRL-0.4 BRL-0.4	BRL - 100 BRL - 100	BRL - 100 BRL - 100	BRL - 100 BRL - 100	4/23/2015 12/8/2016
B-40/RW	GW-2/3	55 14	224 55	BDL-9.41 10	135 33	**69,200** **27,700**	30,600 11,400	**103,000** 28,500	8/29/2012 4/18/2013
B-41/MW	GW-3	BRL - 10	BRL - 10	BRL - 10	BRL - 10	BRL - 100	BRL - 100	BRL - 100	6/24/2011
P-1B/MW	GW-2/3	NT NT NT NT NT NT NT NT BRL - 10 BRL - 10 BRL-0.4 0.9 BRL-0.4 BRL-0.4 BRL-0.4 0.644 BRL-0.4 0.472	NT NT NT NT NT NT NT NT 15.3 37.1 BRL-0.4 BRL - 0.400 BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4 BRL-0.4	NT NT NT NT NT NT NT NT BRL - 10 BRL - 10 3.03 3.39 2.52 3.02 1.14 2.7 2.09 1.95	NT NT NT NT NT NT NT NT BRL - 10 BRL - 10 4.56 4.33 3.27 3.85 1.55 2.97 4.00 1.57	815 996 143 655 128 BRL - 111 114 258 BRL - 100 1,070 143 120 288 BRL - 100 195 BRL - 100 BRL - 100 BRL - 100	401 591 BRL - 100 BRL - 100 BRL - 97.1 BRL - 111 BRL - 103 186 BRL - 100 500 149 115 130 BRL - 100 138 BRL - 100 BRL - 100 BRL - 100	1,180 1,920 727 173 559 375 621 739 845 1,890 943 641 651 452 598 339 536 713	11/19/2003 4/13/2004 11/3/2004 8/16/2005 4/18/2007 11/7/2007 4/2/2008 8/20/2009 6/24/2011 4/18/2012 8/29/2012 6/18/2013 7/31/2015 1/5/2016 12/6/2016 2/23/2017 10/12/2017 8/6/2019
Method 1 GW-2/3 Standards		700/20,000	2,000/20,000	NA/10,000	NA/10,000	5,000/50,000	NA/50,000	50,000/5,000	

Well	GW Category	Naphthalene	2-Methylnaphthalene	Acenaphthene	Phenanthrene	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Date Well Sampled/Gauged
P-3B/MW	GW-2/3	NT	NT	NT	NT	BRL - 100	BRL - 100	BRL - 100	4/18/2001
		NT	NT	NT	NT	- dry -	- dry -	- dry -	10/29/2001
		NT	NT	NT	NT	BRL - 100	BRL - 100	BRL - 100	2/14/2002
		NT	NT	NT	NT	BRL - 100	BRL - 100	BRL - 100	5/16/2002
		NT	NT	NT	NT	158	153	157	11/19/2003
		NT	NT	NT	NT	BRL - 100	BRL - 100	BRL - 100	11/3/2004
		NT	NT	NT	NT	BRL - 100	BRL - 100	BRL - 100	8/16/2005
		BRL - 0.400	BRL - 0.400	BRL - 0.400	BRL - 0.400	BRL - 100	BRL - 100	BRL - 100	6/18/2013
P-4B/MW	GW-2/3	NT	NT	NT	NT	1,670	1,230	1,380	12/30/2003
		NT	NT	NT	NT	196,000	201,000	187,000	11/3/2004
		NT	NT	NT	NT	11,900	13,700	6,450	8/16/2005
		NT	NT	NT	NT	2,260	1,740	3,250	4/18/2007
			BRL - 0.513	BRL - 0.513	BRL - 0.513	209	219	314	1/5/2016
RW-1	GW-2/3	BRL - 0.400	BRL - 0.400	BRL - 0.400	BRL - 0.400	171	129	245	4/18/2013
RW-6	GW-2/3	1.06	3.11	0.65	1.66	3,320	1,950	3,590	6/11/2013
RW-7	GW-2/3	NT	NT	NT	NT	1,610	2,250	2,550	8/16/2005
		BRL - 10	BRL - 10	BRL - 10	BRL - 10	653	609	777	6/24/2011
P-5B/MW	GW-2/3	BRL - 10	11.6	BRL - 10	BRL - 10	2,900	1,240	2,170	6/24/2011
		BRL - 10	37.4	BRL - 10	BRL - 10	3,380	927	3,850	1/18/2012
		149	1,060	179	252	**75,700**	27,100	**75,100**	4/18/2012
		WELL REMOVED AND REPLACED WITH P-5BR/MW							
P-5BR/MW	GW-2/3	6.51	22.30	1.48	2.91	666	295	1,140	4/23/2015
		BRL - 0.533	54.10	11.60	34.60	**25,900**	10,500	**22,300**	12/31/2015
		3.46	18.30	2.34	7.14	2,040	1,100	3,100	12/6/2016
		3.03	24.60	4.14	11.20	**7,380**	2,980	8,370	2/22/2017
		1.75	9.11	1.20	3.13	2,830	1,050	2,680	10/12/2017
P-6B/MW	GW-2/3	NT	NT	NT	NT	13,100	6,590	8,970	4/18/2007
		BRL - 10	14.7	BRL - 10	BRL - 10	1,530	595	1,690	1/18/2012
		WELL REMOVED AND REPLACED WITH P-6BR/MW							
P-6BR/MW	GW-2/3	BRL - 0.400	15.4	BRL - 0.400	6.6	**7,550**	2,720	**6,940**	4/23/2015
		BRL - 27.4	1,860	216	972	**658,000**	**208,000**	**560,000**	1/5/2016
		1/0/1900	1	3.01	8.74	**6,580**	2,270	4,580	8/6/2019
P-7/MW	GW-2/3	0.48	0.567	0.594	2.83	3,240	2,380	3,210	6/11/2013
IW-2	GW-2/3	BRL - 10	14.8	12.7	BRL - 10	6,430	2,850	6,870	5/4/2011
		BRL - 10	34	BRL - 10	BRL - 10	3,330	1,400	3,320	1/18/2012
		BRL - 10	16.8	BRL - 10	BRL - 10	672	210	1,010	4/18/2012
		BRL-0.4	0.444	BRL-0.4	1.14	2,220	1,380	3,400	2/22/2017
IW-3	GW-2/3	BRL - 1.05	BRL - 1.05	BRL - 1.05	BRL - 1.05	BRL - 105	BRL - 105	187	3/24/2010
		5.5	19.2	1.3	5.82	3,420	1,660	3,140	7/31/2015
		2.37	6.97	0.892	2.97	806	468	907	12/31/2015
		4.86	16.9	1.34	4.6	2,140	1,200	2,110	2/22/2017
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	8/6/2019
IW-5	GW-2/3	6.1	22.5	BRL - 1.04	5.34	1,140	658	1,460	1/14/2010
		BRL - 1.04	BRL - 1.04	BRL - 1.04	13	4,040	1,740	3,940	2/14/2011
		13.3	104	21.1	10.4	10,500	4,730	10,800	5/4/2011
		323	22.3	12.8	BRL - 10	BRL - 100	BRL - 100	247	1/18/2012
		54.1	325	68.7	61.6	**30,600**	11,600	**31,000**	4/18/2012
		14.1	33.3	2.64	7.56	3,400	1,180	2,970	2/22/2017
		16.8	84.5	6.78	36.5	978	8,750	**14,200**	10/12/2017
IW-6	GW-2/3	BRL - 1.04	BRL - 1.04	BRL - 1.04	BRL - 1.04	BRL - 104	BRL - 104	BRL - 104	1/14/2010
		BRL - 1.03	BRL - 1.03	BRL - 1.03	BRL - 1.03	BRL - 103	BRL - 103	BRL - 103	6/15/2010
		BRL - 1.09	BRL - 1.09	BRL - 1.09	BRL - 1.09	BRL - 109	120	245	2/14/2011
		0.487	0.782	BRL - 0.400	BRL - 0.400	187	158	373	4/18/2013
		1.19	1.86	BRL - 0.400	BRL - 0.400	537	438	659	6/11/2013
		WELL REMOVED AND REPLACED WITH IW-6R/MW							
IW-6R	GW-2/3	BRL-0.4	0.796	0.802	1.31	172	111	371	4/23/2015
		BRL - 0.4	BRL - 0.4	BRL - 0.4	BRL - 0.4	289	177	300	7/31/2015
		0.896	BRL - 0.548	BRL - 0.548	1.12	811	438	793	12/31/2015
		BRL-0.4	BRL - 0.4	BRL - 0.4	BRL - 0.4	536	428	616	12/6/2016
		BRL-0.4	BRL - 0.4	BRL - 0.4	BRL - 0.4	BRL - 100	BRL - 100	322	2/22/2017
		BRL-0.4	BRL - 0.4	BRL - 0.4	BRL - 0.4	502	375	374	10/12/2017
		BRL-0.4	BRL - 0.4	BRL - 0.4	BRL - 0.4	231	239	403	8/6/2019
IW-7	GW-2/3	BRL - 1.03	BRL - 1.03	BRL - 1.03	BRL - 1.03	BRL - 103	BRL - 103	BRL - 103	1/14/2010
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	4/23/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	124	BRL - 100	7/31/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	1/5/2016
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	12/6/2016
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	2/23/2017
		BRL-0.4	BRL - 0.4	BRL - 0.4	BRL - 0.4	BRL - 100	BRL - 100	130	10/12/2017
IW-8	GW-2/3	BRL - 1.08	BRL - 1.08	BRL - 1.08	BRL - 1.08	164	BRL - 108	537	1/14/2010
		1.83	BRL-0.4	BRL-0.4	8.01	2,090	1,850	2,810	8/29/2012
		BRL-0.4	BRL-0.4	BRL-0.4	0.59	106	120	195	6/18/2013
		BRL - 0.444	BRL - 0.444	BRL - 0.444	BRL - 0.444	116	BRL - 100	186	7/31/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	1,200	1,440	881	2/23/2017
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	305	317	378	10/12/2017
IW-9	GW-2/3	1.69	27.1	2.2	3.36	1,930	1,300	1,660	6/18/2013
		BRL-0.4	2.83	0.75	1.61	698	518	1,080	12/6/2016
		0.688	4.98	1.51	1.63	269	145	392	2/23/2017
		BRL-0.4	1.63	0.89	1.55	634	413	716	10/12/2017
IW-11	GW-2/3	BRL - 1.01	BRL - 1.01	BRL - 1.01	BRL - 1.01	119	102	340	1/14/2010
		BRL - 1.03	BRL - 1.03	BRL - 1.03	BRL - 1.03	138	BRL - 103	328	2/14/2011
		BRL - 10	BRL - 10	BRL - 10	BRL - 10	161	356	245	4/18/2012
LB-51/MW	GW-3	BRL - 0.400	BRL - 0.400	BRL - 0.400	BRL - 0.400	BRL - 100	BRL - 100	BRL - 100	4/23/2015
		BRL - 0.400	0.88	BRL - 0.400	BRL - 0.400	924	358	BRL - 100	7/31/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	12/15/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	118	BRL - 100	12/8/2016
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	2/22/2017
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	10/17/2017
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	684	8/6/2019
LB-52/MW	GW-3	BRL - 0.400	BRL - 0.400	BRL - 0.400	BRL - 0.400	BRL - 100	BRL - 100	BRL - 100	4/23/2015
LB-53/MW	GW-3	BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	4/23/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	659	7/31/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	12/15/2015
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	125	BRL - 100	12/8/2016
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	2/22/2017
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	10/17/2017
		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	8/6/2019
LB-54/MW	GW-2/3	BRL - 0.400	9.79	1.35	3.06	308	131	661	4/23/2015
		BRL-0.4	1.04	0.52	2.14	766	326	435	7/31/2015
		BRL-0.4	1.77	0.65	1.47	379	154	374	12/15/2015
		BRL-0.4	1.16	0.58	0.65	538	230	670	12/6/2016
		BRL-0.4	2.12	1.02	0.61	266	BRL - 100	355	2/22/2017
		BRL-0.4	2.08	0.47	0.62	708	252	515	10/12/2017
		BRL-0.4	0.654	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	327	8/6/2019
LB-55/MW		BRL-0.4	BRL-0.4	BRL-0.4	BRL-0.4	BRL - 100	BRL - 100	BRL - 100	8/6/2019
Method 1 GW-2/3 Standards		700/20,000	2,000/20,000	NA/10,000	NA/10,000	5,000/50,000	NA/50,000	50,000/5,000	

Most recent results that violate applicable standards are highlighted and shown in bold.
Wells categorized solely as GW-3 are compared to GW-3 Standards only.
ND - Not detected above laboratory method detection limits
BRL - Below laboratory reporting limit (Reporting limit indicated after BRL designation)
Some compounds that have been detected but have not exceeded their respective Risk Charactereization Standard are not included in this table
Updated Standards Effective 2014
NT = Not Tested

Table 7. Soil Vapor Screening Data
Horace Mann School
Newton, MA

Well ID	VP-1	VP-2	VP-3	VP-4	VP-5	VP-6	VP-7	VP-8	VP-9	VP-10	VP-11	VP-12	Date
PID Concentration (ppmv)	31	1,000+	70	14.5	5.2	32.5	6.7	6.2	0.5	15.1	7.9	0.1	3/26/2013

Soil gas screening conducted with a Thermo 580B PID

Table 8. Soil Vapor Data - Air-Phase Hydrocarbons
Horace Mann School
Newton, MA

WELL ID	ANALYTICAL RESULTS (ug/m^3)										SAMPLE DATE
	Benzene	1,3-Butadiene	Ethylbenzene	MTBE	Naphthalene	Toluene	Xylenes	C_5 - C_8 Aliphatics	C_9 - C_{12} Aliphatics	C_9 - C_{10} Aromatics	
VP-2	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	18	18	BRL - 10	4/18/2013
VP-3	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 12	17	BRL - 10	4/18/2013
VP-4	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 12	20	BRL - 10	4/18/2013
VP-6	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	BRL - 2.0	13	14	BRL - 10	4/18/2013
Residential Soil Gas Screening Values	160	NV	520	2,700	42	3,800	1,400	4,100	4,800	700	
Commercial/Industrial Soil Gas Screening Values	770	NV	62,000	190,000	190	310,000	6,200	23,000	15,000	3,100	

(BRL) None detected - Below Method Reporting Limit.
Items in Bold and shaded ndicate exceedance of a Threshold Value.
Threshold Values as listed in Interim Final Vapor Intrusion Guidance, WCS 11-435, December 2011 and revised March 7, 2013.
NV - No Value

Table 9
Summary of Indoor Air Sampling
Horace Mann School
Newton, Massachusetts

Sample ID	Analytical Result & Background Values (all data in µg/m^3)											Date
	1,3-Butadiene	MTBE	Benzene	Toluene	Ethylbenzene	m-,p-Xylenes	o-Xylene	Naphthalene	C5-C8 Aliphatics	C9-C12 Aliphatics	C9-C10 Aromatics	
Gym	BRL-2.0 BRL-0.50	BRL-2.0 BRL-0.70	BRL-2.0 BRL-0.60	4.1 1.2	BRL-2.0 BRL-0.90	BRL-4.0 BRL-0.90	BRL-2.0 BRL-0.90	BRL-2.0 BRL-0.05	42 BRL-10	14 BRL-10	BRL-10 BRL-10	4/17/2013 12/28/2016
Lunch Prep Room	BRL-2.0 BRL-0.50	BRL-2.0 BRL-0.70	BRL-2.0 BRL-0.60	4.0 1.8	BRL-2.0 BRL-0.90	BRL-4.0 BRL-0.90	BRL-2.0 BRL-0.90	BRL-2.0 0.055	49 BRL-10	BRL-14 BRL-10	BRL-10 BRL-10	4/17/2013 12/28/2016
Assemby Room	BRL-2.0 BRL-0.50	BRL-2.0 BRL-0.70	BRL-2.0 BRL-0.60	7.2 2.1	BRL-2.0 BRL-0.90	BRL-4.0 BRL-0.90	BRL-2.0 BRL-0.90	BRL-2.0 BRL-0.05	**80** BRL-10	23 16	BRL-10 BRL-10	4/17/2013 12/28/2016
Residential Threshold Values	*NVS*	39	2.3	54	7.4	20	20	0.6	58	68	10	
Commercial Threshold Values	*NVS*	2,600	11	4,400	880	88	88	2.7	330	220	44	
MCP Imminent Hazard levels*	*NVS*	30,000	21	50,000	10,000	1,000	1,000	30	2,000	2,000	500	
Typical Residential Indoor Air**	*NVS*	*6.9-39*	*3.6-11*	*21-54*	*2.4-7.4*	*9.4-28*	*9.4-28*	*ND-2.7*	*130-330*	*110-220*	*ND-44*	

Notes:

Residential and Commercial Threshold Values taken from MADEP Interim Final Vapor Intrusion Guidance, WSC-11-435 dated December 2011 and updated March 7, 2013.

*MADEP, Standard Operating Procedure for Indoor Air Contamination. SOP#BWSC-07-01, August 2007, Section III, Table 1: "Residential/School Criteria."

** MADEP, Technical Update December, 2008, UPV = Upper Percentile Values in µg/m^3 as set by DEP for *typical* indoor air concentrations at residences and schools

Bold values indicate an exceedence of a screening value

NVS = No Value Set by DEP

TABLE 11
Soil Extractable Petroleum Hydrocarbon Data (with Diesel Range Organics)
Horace Mann School, 687 Watertown Street, Newton, MA
Soil Samples Collected on 12/29/09 and 12/30/09

SAMPLE ID	ANALYTICAL RESULT (mg/kg)							Date
	Naphthalene	2-Methylnaphthalene	Acenaphthene	Phenanthrene	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	
B-29, 8'-12'	NT	NT	NT	NT	BRL - 10	BRL - 10	BRL - 10	4/13/2001
B-30, 8'-12'	NT	NT	NT	NT	224	105	193	4/13/2001
B-36, 8'-12'	NT	NT	NT	NT	27	28.4	**1,080**	4/13/2001
B-37, 8'-12'	NT	NT	NT	NT	BRL - 10	55.5	226	9/17/2001
B-41, 8'-12'	NT	NT	NT	NT	BRL - 10	41.1	24.1	9/17/2001
B-42, 8'-12'	NT	NT	NT	NT	BRL - 10	23.2	14	9/17/2001
RW-2, 5'-7'	1.2	0.9	0.7	19.8	99	117	549	4/21/2003
RW-2, 12'-15'	0.5	0.9	0.4	10.8	247	159	466	4/21/2003
RW-3, 5'-7'	BRL - 0.025	BRL - 0.025	BRL - 0.05	1.1	12.9	49.8	59.2	4/21/2003
RW-3, 12'-15'	1.6	12.2	0.7	8.3	**2,370**	771	548	4/21/2003
RW-4, 5'-7'	BRL - 0.025	BRL - 0.025	BRL - 0.05	3	10.5	31.3	568	4/21/2003
RW-4, 12'-15'	0.8	8.6	BRL - 0.05	1.9	**1,990**	686	562	4/21/2003
RW-5, 5'-7'	0.2	0.3	0.7	11.5	46.7	127	558	4/21/2003
RW-5, 12'-15'	0.9	3.2	0.8	10.2	929	471	556	4/21/2003
IW-2, 8-10'	BRL - 0.127	BRL - 0.127	BRL - 0.128	BRL - 0.127	108	74.6	111	12/29/2009
IW-3, 8-10'	BRL - 0.114	BRL - 0.114	BRL - 0.115	BRL - 0.116	BRL - 17	BRL - 17	22	12/29/2009
IW-5, 6-8'	BRL - 0.111	**4.99**	BRL - 0.111	2.01	659	384	594	12/29/2009
IW-6, 6-8'	BRL - 0.111	BRL - 0.111	BRL - 0.111	BRL - 0.111	BRL - 16.7	BRL - 16.7	26.2	12/29/2009
IW-7, 6-8'	BRL - 0.111	BRL - 0.111	BRL - 0.111	BRL - 0.111	BRL - 16.7	17.2	25.6	12/30/2009
IW-8, 6-8'	BRL - 0.115	0.124	BRL - 0.115	0.195	208	30.3	68.3	12/30/2009
IW-9, 6-8'	BRL - 0.112	BRL - 0.112	BRL - 0.112	BRL - 0.112	22.1	18	30.2	12/30/2009
IW-11, 12-14'	BRL - 0.119	BRL - 0.119	BRL - 0.119	BRL - 0.119	40	36.9	78	12/30/2009
B-37R, 10'-15'	BRL - 0.348	1.21	BRL - 0.348	0.44	124	73.2	166	8/18/2014
LB-51, 10'-15'	BRL - 0.353	BRL - 0.353	BRL - 0.353	BRL - 0.353	BRL - 7.05	BRL - 7.05	BRL - 7.05	8/18/2014
LB-52, 10'-15'	BRL - 0.397	BRL - 0.397	BRL - 0.397	BRL - 0.397	BRL - 7.95	8.26	16.1	8/18/2014
MCP Method 1 Cleanup Standards S-1 (GW-1/2/3) (mg/kg)	*4/40/500*	*0.7/80/300*	*4/1,000/1,000*	*10/500/500*	*1,000/1,000/1,000*	*3,000/3,000/3,000*	*1,000/1,000/1,000*	
MCP Method 1 Cleanup Standards S2 (GW-1/2/3) (mg/kg)	*4/40/500*	*0.7/80/500*	*4/3,000/3,000*	*10/1,000/1,000*	*3,000/3,000/3,000*	*5,000/5,000/5,000*	*1,000/3,000/3,000*	

NT - Not Testesd
BRL denotes Below Reportable Limit
BOLD indicates exceedence of a standard

APPENDIX A

APPENDIX B

R-25

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Manifest Tracking Number
	MAR000536730	1	508-828-1005	003066093 GBF

GENERATOR

5. Generator's Name and Mailing Address
City of Newton
687 Watertown Street
Newton, MA. 02460
Generator's Phone: (781)255-5554 508-828-1005

Generator's Site Address (if different than mailing address) (Same)

6. Transporter 1 Company Name: Global Remediation Services Inc. U.S. EPA ID Number: MAC300012803

7. Transporter 2 Company Name U.S. EPA ID Number

8. Designated Facility Name and Site Address
Tradebe Treatment & Recycling of Stoughton, L
441R Canton St.
Stoughton, MA 02072 USA
Facility's Phone: 781-297-3530
U.S. EPA ID Number: MAD082179890

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
X	1. NA1270, Petroleum Oil, 3, PGII	001	TT	1330	G	MA08		
	2.							
	3.							
	4.							

14. Special Handling Instructions and Additional Information
Profile # ~~4445SLH~~ ~~City Water~~ ~~ERQ#128~~
1100246219

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: Arthur Cabral Signature: Arthur Cabral Month: 11 Day: 11 Year: 20

INT'L

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Robert Preston Signature: Robert Preston Month: 02 Day: 11 Year: 20

Transporter 2 Printed/Typed Name Signature Month Day Year

DESIGNATED FACILITY

18. Discrepancy

18a. Discrepancy Indication Space ☑ Quantity ☐ Type (1,311 gals) ☐ Residue ☐ Partial Rejection ☐ Full Rejection
(5,245 tons)
actual weight per slip = 10,490 lbs Manifest Reference Number:

18b. Alternate Facility (or Generator) U.S. EPA ID Number
Facility's Phone:

18c. Signature of Alternate Facility (or Generator) Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1.	2.	3.	4.
H110			

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name: Kristen Marrelli Signature: Kristen Marrelli Month: 12 Day: 11 Year: 20

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

TRANSPORTER'S COPY

R33/V44

Please print or type. (Form designed for use on elite (12-pitch)typewriter.)

NON-HAZARDOUS WASTE MANIFEST	1. Generator ID Number: N/A	2. Page 1 of	3. Emergency Response Phone	4. Manifest Tracking Number: 2020106-01

GENERATOR

5. Generator's Name and Mailing Address: City of Newton, 687 Watertown Street, Newton, MA 02460

Generator's Site Address (if different than mailing address): (SAME)

Generator's Phone:

6. Transporter 1 Company Name: Global Remediation Services Inc.

U.S. EPA ID Number: MAC300012903

7. Transporter 2 Company Name

U.S. EPA ID Number

8. Designated Facility Name and Site Address: Globalcycle, Inc, 700 Richmond Street, East Taunton, MA 02718

U.S. EPA ID Number: N/A

Facility's Phone: 508-823-1005

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit WL/Vol	
	1. Non-DOT/Non-SCRA Regulated Liquid (Non Hazardous Waste Water)	001	TT	8300	G	
	2.					
	3.					
	4.					

13. Special Handling Instructions and Additional Information: PH 7.0 VIS OK

Profile # C-1180-001

Plate # 1642A MA.

14. **GENERATOR'S CERTIFICATION:** I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Generator's/Offeror's Printed/Typed Name: Arthur Cabral | Signature: Arthur Cabral | Month: 01 | Day: 06 | Year: 20

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter signature (for exports only): Date leaving U.S.

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Michael Raposa | Signature: Michael J. Raposa | Month: 01 | Day: 06 | Year: 20

Transporter 2 Printed/Typed Name | Signature | Month | Day | Year

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) | U.S. EPA ID Number

Facility's Phone:

17a. Signature of Alternate Facility (or Generator) | Month | Day | Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: Steve Ivester | Signature: Steve Ivester | Month: 2 | Day: 6 | Year: 20

ITEM# WM550 To Reorder Call - Pro's Choice Printing, Inc. 1-888-801-1515 www.proschoiceprinting.com

1-DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

3-2019

APPENDIX C

SITE SPECIFIC HEALTH AND SAFETY PLAN

for the Site:

Horace Mann School

687 Watertown Street
Newton, Massachusetts

prepared September 3, 2019

Prepared by:

Lord Associates, Inc.
1506 Providence Highway, Unit 30
Norwood, Massachusetts 02062

SECTION 1 - INTRODUCTION

1.1 Introduction

The purpose of this Health and Safety Plan is to identify, evaluate and control health and safety hazards and to provide for emergency response for any accidents that may occur during planned work at the Horace Mann School located at 687 Watertown Street in Newton, Massachusetts.

.

Objectives of the document include but are not limited to the following:

- Regulations
- Organization/Administration
- Hazard Communication Training
- Medical Surveillance
- Exposure Monitoring
- Health and Safety Equipment
- Standard Operating Procedures
- Identification and evaluation of potential and unanticipated hazards
- Definition of levels of protection required for certain work activities
- Establishment of work zones
- Formation of emergency action plans
- Development of personnel training
- Development of decontamination procedures

Information and guidelines used to develop this Site Safety and Health Plan (SSHP) are based upon the following documents:

1. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, A. D. Little, Inc., January 1981.

2. Dangerous Properties of Industrial Materials, Sax, 1979.

3. Toxic and Hazardous Industrial Chemicals Safety Manual, The International Technical Information Institute, 1979.

4. American National Standard Practices for Respiratory Protection, Z288.1-180, May 22, 1980.

5. Respiratory Protection: A Manual and Guideline, American Industrial Hygiene Association, 1st edition, 1980.

Lord Associates, Inc. views the Site Specific Safety and Health Plan (SSHP) as an important document that is necessary to the success of the site work. Every effort has been made to ensure that the SSHP shall be in compliance with applicable federal, state and local regulations.

Sections 1.0 - 12.0 are the site-specific portions of the SSHP. These sections are intended to be the working document for the site. The Standard Operating Procedures are, for the most part, general policies and procedures and are incorporated for reference.

The purpose and intent of the SSHP is to ensure that site work is always conducted in a safe manner. The on-going program shall be directed at recognizing and dealing with the specific site hazards. Along with site personnel safety, a second major objective is to perform site operations in such a manner as to minimize the possibility of fire, explosion, or any unplanned or sudden release of hazardous waste contaminants into the environment that could adversely affect local receptors. The SSHP has been developed to meet these essential objectives and promote the safe execution of this project.

The SSHP shall be constantly reviewed and may be modified throughout the site work to ensure flexibility and adaptability as changes occur and new situations develop. These changes shall be reviewed and approved by Lord Associates, Inc. and the City of Newton. Any changes to the plan shall be brought to the attention of those covered under the plan through additional training.

Several Standard Operating Procedures (SOPs) are attached to this SSHP as references for preventing accidents and protecting personnel from injury and occupational illness for all operations having significant accident potential. They are required to be read and followed by all site personnel.

SECTION 2 - ORGANIZATION AND SAFETY RESPONSIBILITY

2.1 Introduction

Implementation of the comprehensive safety and health program is a line management responsibility. The SSHP shall include a listing of key supervisory, management, and health/safety personnel, and a description of their specific responsibilities for implementation of the program. Clear lines of authority, consistent with good operating policies and procedures, have been established for enforcing safety compliance. The qualifications of the site safety and health personnel are included in the appendices. The following health and safety organization shall be used.

2.2 Line Management

Oliver Leek, Project Manager (Lord Associates, Inc.), shall be monitoring the project for environmental hazards and soil handling. He shall have overall responsibility for field implementation of the SSHP by Lord Associates, Inc. Employees, and no other third parties.

2.3 Site Safety and Health Officer (SSHO)

As SSHO for the Project, Mr. Oliver Leek shall serve as the person with the responsibility of monitoring site health and safety for on-site workers. The SSHO shall be familiar with all matters pertinent to this project. The SSHO shall be responsible for coordinating the enforcement of the contents of the SSHP. Private contractors employed to perform any work associated with this project shall be given a copy of the Health and Safety Plan and shall be required to appoint their own SSHO. Mr. Leek *is not* responsible for the safety of other private contractors.

Mr. Leek or the SSHO working for any contractor on site is also to be empowered to deny access to the site or restrict the presence of any persons (under his control); in addition, the aforementioned and also have the authority to cease activities on-site if and when conditions present uncontrollable risks to site personnel and off-site receptors. The SSHO shall also be responsible for coordinating, conducting and documenting any required training activities, performing and maintaining Record keeping duties, and carrying out any other duties specified by site management. The SSHO shall be the main contact for any on-site emergency situation. Except in an emergency, the SSHO may modify the approved SSHP only after consultation and concurrence of the Corporate Safety Officer.

In addition, the SSHO shall monitor work locations for employee health and safety purposes, as well as document any employee exposures and/or substance releases that may occur through the course of this project. The SSHO shall be trained and experienced to be proficient in the proper use and limitations of all equipment to be used. The SSHO shall be responsible for operating the equipment, assisting in implementing the SSHP, and performing any other duties assigned to them.

2.5 Training and Site Briefing

The SSHO shall keep records of all training and proof of training for all site personnel and site visitors. Copies of the training records for all workers associated with the project are included as part of the SSHP.

1. Training Requirements

   All site personnel are required to provide proof of having training which meets the initial 40-hour and 8-hour refresher training for hazardous waste site workers of 29 CFR 1910.120. This includes the three days of supervised on-site training. Personnel are also required to have Hazard Communication Training which meets the requirements of OSHA 29 CFR 1910. Proof of this training is included in the appendices.

2. Site Safety and Health Briefing

Personnel covered by this SSHP shall be required to read and understand this document. Prior to *any* on-site activity, all site personnel and visitors shall be required to attend a site safety and health briefing from the SSHO or other qualified person. This is applicable to all personnel located within the Exclusion, Contaminant Reduction, and Support Zone who are involved with site work. Periodic updates shall be undertaken by the SSHO when operational or site conditions change or when designated refreshers are so warranted. The topics to be covered by the training include the entire contents of the SSHP with emphasis on emergency procedures, areas of restricted access, methods of decontamination, and general safety.

A safety meeting shall be held for all site personnel and shall be conducted by Project field supervisors or foremen. After the meeting, a report shall be completed. See Appendices for a sample copy of the Weekly Safety Meeting form.

2.6 First Aid

First aid kits shall be available at the site in the Support Zone that shall be established near the work areas. If necessary, an ambulance service shall be called for transport of severely injured persons to the hospital. At least one person trained in first aid/CPR shall be available on-site at all times when workers are present.

2.7 Emergency Medical Care

Emergency medical care services are available at Newton Wellesley Hospital on Rte 16. Section 11 contains information regarding emergency transport to the hospital.

2.8 Accident Reporting and Record keeping

Lord Associates, Inc. has prepared an accident prevention program as a separate submittal for work on the site which provides for accident reporting and Record keeping. Lord Associates, Inc. shall immediately notify the Owner of any accident/incident.

2.9 Daily Safety Inspections

As necessary, the SSHO shall conduct daily safety inspections of the site to determine compliance with the SSHP. These inspections shall be systematic and shall occur at different times each day. Copies of all safety inspections shall be available from the Lord Associates upon request.

SECTION 3 - SITE CHARACTERIZATION AND ANALYSIS

3.1 Site Information

The work site shall be the property located at the Horace Mann School in Newton, Massachusetts. Work shall include the excavation of residually-impacted soil. Impacts soil will be disposed of off-Site.

3.2 SSHP Application and Coverage

This SSHP applies to the evaluation and handling of contaminated groundwater and/or soils that may be encountered during the course of the work.

3.3 Chemical Health Hazards

Site characterization data reveals that the following hazardous materials may be encountered on the site:

- Petroleum Contaminated Soil/Groundwater

Exposure risks for the work are primarily through respiratory exposure through inhalation of volatile compounds. Ambient air monitoring at the site shall be conducted with portable direct reading instruments. If concentrations exceed the upgrade criteria for the contaminants, a decision shall be made to change the level of protection according to the criteria described in Section 6.

3.4 Safety Hazards

Caution should be exercised when near heavy machinery on the site. The entire area is a hard hat area. Workers shall be advised of all known hazards at the site prior to startup and thereafter as needed. They shall be encouraged to be observant of site safety and health hazards and to report them to their supervisors and/or the SSHO.

3.5 Unanticipated Hazards

The following conditions and situations are not anticipated at this site and therefore safety procedures appropriate to them are not included in this SSHP: the need to handle or open drums or containers that may contain hazardous substances; activities requiring personal protective equipment more extensive than Level C (described in Section 6); and field work in non-illuminated areas during periods of darkness. If any of these conditions are encountered, the SSHO is to immediately contact representatives of Lord Associates and the Corporate Safety Officer in order to define a proper response.

3.6 Biological Hazards - none

3.7 Site Inspections by the SSHO

At least every thirty minutes during field operations, the SSHO shall visually inspect all site activities for compliance with this Plan. The results of this inspection shall be recorded in the log. Deficiencies in compliance shall be corrected upon discovery and noted in the log.

SECTION 4 - SITE CONTROL

Site control zones shall be established in order to reduce hazards to the smallest area possible. The SSHO shall ensure that each employee has the proper personal protective equipment for the area or zone in which he or she is to perform work.

4.1 Exclusion Zone

The Exclusion Zones are defined as any area on the site that is within 10 feet of injection activities. In general, all trenching, excavation and excavated materials storage areas shall be considered within the Exclusion Zone. The required protective equipment for use by personnel working or entering the exclusion areas is specified in Section 7.

The Exclusion zone shall be established once activities in the areas of injections are ready to commence. Access to the Exclusion Zone shall be restricted to personnel who are wearing the proper personal protective equipment and have received the required site training. Eating, drinking or smoking is prohibited in this area. The Exclusion Zone shall be expanded by the SSHO if site conditions warrant this action.

4.2 Support Zone (Non-Contaminated)

The Support Zone encompasses the remainder of the site. The Support Zone contains the following: lunch area, break areas, support operations and storage and maintenance facilities. Eating, drinking, smoking, and chewing are permitted only in this area. Access to the Support Zone shall be restricted to site personnel and invited visitors since construction activities may pose a physical hazard.

SECTION 5 - SITE ACTIVITIES

The proposed scope of services has been described in Section 1.0. During the course of site activities, various tasks shall be undertaken that may result in the exposure of project personnel to potentially hazardous materials. The following is a brief description of task activities that shall be conducted during the course of this project:

5.1 Daily Site Work

During daily site work, the SSHO shall enter the work areas to verify existing conditions and monitor for the presence of airborne contaminants. Direct reading field instruments shall be used to determine baseline levels of suspected exposure contaminants. Although unlikely, the potential exists that certain site work may result in

confined space situations. In this event, monitoring for the presence of an oxygen deficient and explosive atmosphere shall be undertaken. Also, during the course of this task-intrusive activity, monitoring shall be performed to determine any change of site conditions.

Air monitoring shall be required to determine variations in organic compound levels. Work shall be conducted in a manner to minimize inhalation or direct contact exposure to hazardous contaminants.

5.2 Hazard Assessment

The following is a summary listing of potential hazard conditions as identified in accordance with the previously referenced tasks.

HAZARD EVALUATION

Task	Low	Medium	High
1 - Contaminated soil and groundwater removal		X	

SITE OPERATING PROCEDURES/SAFETY GUIDELINES

- All safety equipment and protective equipment shall be worn at all times in designated areas, by all persons, in conformance with the SSHP.
- Always observe the buddy system. Never enter or exit site alone, and never work alone in an isolated area. Never wander off by yourself.
- Always maintain a line-of-sight.
- Practice contamination avoidance. Never sit down or kneel, never lay equipment on the ground, avoid obvious sources of contamination such as puddles, and avoid unnecessary contact with on-site objects.
- No eating, drinking, or smoking outside the designated Support zone.
- In the event Personal Protective Equipment is ripped or torn, work shall stop and it shall be removed and replaced as soon as possible.
- Be alert to any unusual changes in your own condition; never ignore warning signs. Notify SSHO as to suspected exposures or accidents.
- A vehicle shall be readily available exclusively for emergency use. All personnel going on-site shall be familiar with the most direct route to the nearest hospital.
- In the event of direct skin contact, the affected area shall be washed immediately with soap and water.
- Copies of the SSHP shall be readily accessible at the command post. Note wind direction. Personnel shall remain upwind whenever possible during on-site activities.
- Never climb over or under refuse or obstacles. Use safety harness/safety lines when sampling lagoons, stream beds, and ravines with steep banks.
- Hands and face must be thoroughly washed before eating, drinking, etc.

- Any modifications to this safety plan **MUST** be approved by the Site Safety and Health Officer.

SECTION 6 - LEVELS OF PROTECTION

6.1 Introduction

Personal protective equipment (PPE) is the primary method used to minimize potential employee exposure to possible hazards. The levels of protection for on-site personnel have been based on OSHA requirements. All on-site personnel shall have their own personal safety equipment which shall be used according to the direction of the SSHO. All PPE shall be kept clean and maintained in a proper manner. Personnel shall have been trained in the use and maintenance of PPE and shall be properly fitted prior to beginning site activities.

It is unlikely that personnel will be exposed above the Permissible Exposure Limits (PELs), Threshold Limit Values (TLVs), or will encounter conditions that are immediately dangerous to life and health (IDLH). Therefore, no special engineering controls or extraordinary work practices are deemed necessary. It is also unlikely that there shall be releases of chemical substances to the environment at health effect levels.

Although the site is considered to have a low hazard evaluation, contingencies have been made to upgrade the site to Level B if necessary. If conditions requiring Level A are encountered, the site shall be evacuated and work shall be stopped until a new SSHP is prepared that reflects the more critical requirements of this level of work is prepared.

6.2 Air Monitoring for Worker Protection

Air monitoring with a photoionization detector (PID), oxygen/LEL meter, and visual observation of airborne dust levels shall be conducted at least every half hour and as appropriate (nearly continuously if readings indicate the necessity) during each day in the work areas. Monitoring shall be conducted on a more frequent basis if necessary as determined by site conditions, e.g. whenever working at Level C or B, continuous real time monitoring shall be conducted.

Description of the Levels of Protection

The following is a brief description of levels of protection to be used by site personnel:

Level D:	Work Clothes Safety Shoes Gloves Hard Hat
Modified Level D:	Chemically Resistant Suit - Tyvek Outer Rubber Slush Boots Outer Chemically Resistant Gloves - Butyl/Neoprene Gloves Hard Hat Safety Shoes Safety Glasses or Face Shield
Level C:	Full Face Respirator with appropriate cartridges. Chemically Resistant Suit - Tyvek Outer Rubber Boots Outer Chemically Resistant Gloves - Butyl/Neoprene Inner Gloves - cotton Hard Hat Safety Shoes Safety Glasses or Face Shield

Level B: Self Contained Breathing Apparatus
Chemically Resistant Suit - Tyvek
Outer Rubber Boots
Outer Chemically Resistant Gloves - Butyl/Neoprene
Inner Gloves - cotton
Hard Hat
Safety Shoes
Safety Glasses or Face Shield

Site Activities Classification

Entry Task	Level of Protection	Upgrade/ Downgrade
1 - Daily Site Work	D	Upgrade to Modified D or C Modified D or C, or B

6.4 Upgrade Criteria

Upgrade from Level D to Modified Level D shall occur when work clothing or skin contact with contaminated soils or hazardous materials is possible. Upgrade from Level D or Modified Level D to Level C (air purifying respirator) may occur under any of the following conditions:

- Ambient volatile organic compound levels exceed five (5) parts per million (ppm) above background for a continuous five (5) minute duration as monitored with a photoionization (PID) general survey instrument.
- On-site personnel monitoring or direct reading instrument survey indicates that appropriate Threshold Limit Values (TLV's) for specific compounds are being exceeded.
- Levels of visible dust from the site are airborne in the breathing zone of the employees. This condition may also result in an upgrade to Modified Level D in order to provide enhanced protective clothing.

Upgrade to Level B may occur under any of the following conditions:

- Ambient volatile organic compound levels exceed fifty (50) parts per million (ppm) above background for a continuous five (5) minute duration as monitored with a PID general survey instrument.
- Any detectable amount of airborne PCBs are detected with Drager Tubes.
- An oxygen meter reading of 19.5% or less.

6.5 Downgrade Criteria

Downgrade from Level C shall occur when ambient volatile organic compound levels fall below five (5) ppm above background as monitored on a PID general survey instrument for five (5) minutes, or when ambient dust levels are no longer visible or below corresponding Threshold Limit Values (TLV's). Downgrade from Level C or Modified Level D may also occur if visible dust levels decline and/or are controlled through dust suppression techniques.

Downgrade from Level B shall occur when ambient volatile organic compound levels fall below fifty (50) ppm above background as monitored on a PID general survey instrument for five (5) minutes or longer. It shall also occur when there are no detectable amounts of airborne PCB vapors detectable.

6.6 Evacuation Criteria

If the site is operating at Level B, any of the following conditions shall require evacuation of the work area:

- A PID sustained reading greater than 500 ppm for 5 minutes or more as monitored in the breathing zone.
- A combustible gas meter indication of 10% of the lower explosive limit.
- A PID sustained concentration exceeding the maximum allowable concentration specified on an air purifying respirator filter cartridge: Generally 1,000 ppm total organic vapor.

SECTION 7 - PERSONAL PROTECTIVE EQUIPMENT

7.1 Provision of Equipment

Appropriate personal protective equipment (PPE) for site workers shall be provided. Failure to use the appropriate equipment shall be grounds for dismissal from the site.

7.2 Personal Protective Equipment Program

A Personal Protective Equipment (PPE) Program shall be implemented for the site. This program is contained in SOP Number 1, attached to this SSHP. Section 8.0 contains the Respiratory Protection Program.

7.3 Decontamination

PPE shall be disposed of or decontaminated in accordance with Section 10.0 when leaving the Exclusion Zone.

7.4 Preliminary Levels of Protection

Preliminary personal protective equipment to be used at the site is described in Section 6.0. These levels may be changed based on ambient air monitoring by the SSHO with the approval of the site management. The general requirements for the different levels of protection at this site have been specified; however, the protective items within each class may be added to or downgraded by the SSHO depending on site conditions or work activities.

SECTION 8 - RESPIRATORY PROTECTION

8.1 Introduction

Appropriate respiratory protection may be required for on-site personnel exposed to suspected hazardous contaminants through inhalation. In general, the primary respiratory hazard shall consist of exposure vapors in the trench or manholes or sewers. If volatile organic compounds are determined to be present at levels requiring an upgrade, then full-face air purifying respirators (MSA manufacture or equivalent) with dual organic vapor/dust mist cartridges (MSA GMC-H or equivalent) shall be used.

If upgrading the site to Level C is necessary, all employees who are required to wear air purifying respiratory equipment shall be required to show proof of medical examination which indicates that the employee is capable of wearing such a device. Training and fit testing for use of air purifying respirators is also necessary.

8.2 Standard Operating Procedures for Respirators

The following are standard use operations to be employed when employees are to wear designated air purifying respirators:

1. MSA Ultra-Twin Full Face Respirator (or equivalent)

   In the event volatile organic compounds are detected at levels requiring an upgrade, a full-face respirator with organic cartridges shall be used. Respirators (e.g., MSA Ultra-Twin) shall be cleaned daily according to procedures prescribed by the manufacturer. Organic vapor cartridges shall be used and replaced either daily, or if breakthrough is detected, at anytime while in use. Negative and positive

pressure fit checks shall be performed daily by each individual respirator wearer upon donning the respirator. The following checks shall be performed on a daily basis in addition to the above:

- Exhalation Valve - pull off plastic cover and check valve for debris or for tears in the neoprene valve (which could cause leakage).
- Inhalation Valves (two) - screw off cartridges and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place.
- Make sure a protective lens cover is attached to the lens. Lenses are expensive to replace and should be protected at all times.
- Make sure you have the right cartridge.
- Make sure that the facepiece harness is not damaged. The serrated portion of the harness can fragment, thus preventing proper face seal adjustment.
- Make sure the speaking diaphragm retainer ring is hand tight.

SECTION 9 - INSTRUMENTATION

9.1 Introduction

The following is a listing of on-site monitoring instrumentation that shall be employed during the course of the site work. Personnel operating this instrumentation shall be fully trained and experienced in the use and operation.

9.2 Site Monitoring Equipment

___ Dual LEL/Oxygen Meter
___ Photoionization Detector with 10.0 or 10.6 eV lamp
___ HydroLab water quality meter

9.3 Confined Space Entry

Because entry into confined spaces such as trenches, pits, or manholes may occur, anyone entering these areas must be trained in Confined Space Entry techniques as outlined in the attached SOPs. When using an oxygen/LEL meter, if the alarm sounds, immediate evacuation is required. The alarms for the instruments must be set at 19.5% for the oxygen meter and 10% of the LEL for the combustible gas meter.

SECTION 10 - DECONTAMINATION

10.1 Introduction

Appropriate decontamination activities shall be conducted whenever site workers leave the contaminated area. Designated locations shall be identified for decontamination of personnel and equipment. The following is a description of procedures to be performed.

10.2 Personnel Decontamination

Decontamination procedures shall be followed by all personnel leaving the sites. Under no circumstances (except emergency evacuation) shall personnel be allowed to leave the site prior to decontamination.

When worn, disposable items (i.e., Tyvek coveralls, inner gloves, and overboots) shall be changed on a daily basis as required unless there is a reason to change sooner. Respirator cartridges shall be changed daily, unless more frequent changes are deemed appropriate, such as breakthrough.

Washing facilities and/or other designated equipment shall be available in the decontamination area for wash down and cleaning of personnel, samples and equipment. If non-disposable equipment (i.e., boots, gloves, respirators, etc.) are visibly contaminated with oil or grease, they should be washed at the end of the shift with a surfactant such as Alconox, methanol and water or equivalent, and rinsed with water. Workers are to segregate and

store their personal protective equipment separate from their personal clothing. In no circumstances are workers allowed to take from the site or wear home any contaminated clothing or equipment.

10.3 Small Equipment Decontamination

Small equipment shall be protected from contamination as much as possible by covering the instruments with plastic (to the extent feasible) without hindering operation of the unit. Contaminated equipment shall be cleaned as needed. The units shall be checked, standardized, recharged as necessary for the next day's operation, and then prepared with new protective coverings.

10.4 Disposal of Decontaminated Materials

It is anticipated that excavation and earth moving equipment may be contaminated during site activities. They shall be cleaned and decontaminated followed by a water wash and rinse. Loose material shall be removed with a brush. The person performing this activity shall usually be at least at the level of protection utilized during the personnel and monitoring equipment decontamination. All protective gear, decontamination fluids (for both personnel and equipment), and other disposal materials shall be collected and disposed of at each site in accordance with applicable regulations.

SECTION 11 - EMERGENCY/CONTINGENCY PLANNING

11.1 Emergency/Contingency Plan

This section identifies the emergency contingency planning undertaken for operations at the site. Other sections provide further information to be used under emergency conditions. Refer to the emergency telephone numbers, routes to emergency medical facilities, and emergency signals.

11.2 Evacuation

Withdrawal Upwind - When conditions warrant moving away from the work site, the crew shall relocate upwind at a distance of approximately 100 feet or farther, as indicated by site monitoring instruments. In the event of withdrawal, the SSHO and a member of the crew (the buddy system must be used) may return to the work site to determine if the condition noted is transient or persistent.

If persistent levels of air contaminants remain, an alarm should be sounded to notify personnel of the situation and the need to leave the site. The site management shall be notified of conditions. When site access is restricted, thus hindering escape, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

Site Evacuation - When conditions warrant site evacuation, the work party shall proceed upwind of the work site and notify the SSHO, security force, and field office of site conditions.

11.3 Emergency Medical Treatment/First Aid

First aid shall be rendered to any person injured on-site as necessary. The injured person shall then be transported for further examination and/or treatment. The preferred transport method is a professional emergency transportation service; however, when this is not readily available or would result in excessive delay, other transport is authorized. Under no circumstances shall injured persons transport themselves to a medical facility for emergency treatment.

If an injury occurs in a downrange position, provisions for decontamination of the victim shall be made. However, life threatening conditions may preclude normal decontamination procedures. In such cases, arrangements shall be made with the medical facility and transporter to provide for the situation. Information on this is listed in Section 11.11, Emergency Information.

11.4 Heat Stress

SOP #3 deals with the signs, symptoms, and first aid for heat stress victims. Monitoring for heat stress should begin whenever the work area temperature exceeds 70 F. The procedures for monitoring heat stress shall be to measure the radial heart rate (pulse) during a 30 second interval at the beginning of a rest period. If the heart rate exceeds 110 beats per minute, shorten the next work cycle by one-third, while keeping the rest period the same length. If the heart rate exceeds 110 beats per minute at the beginning of the next rest period, shorten the following

work cycle by one-third. Continue monitoring and shortening work cycles until the heart rate is less than 110 beats per minute.

11.5 Cold Stress

SOP #3 deals with the signs, symptoms and first aid for cold stress victims. Monitoring for cold stress should begin whenever the work area temperature drops below 70 F. Employees should be aware of the symptoms of cold stress and frost bite. If any signs or symptoms appear, report it immediately to the SSHO. Take immediate action to prevent injury.

11.6 Noise Exposure

Employees must be aware that noise exposure may occur during operations on the site. If there is any concern regarding noise levels on the site, Lord Associates, Inc. shall arrange for noise monitoring to be conducted by the CIH. If noise levels are found to be excessive, personal protective devices such as hearing protectors (plugs and muffs) shall be made available for the employees.

11.7 Illumination

Site operations shall not be permitted without adequate lighting: at least 5 footcandles. Therefore, unless provisions are made for artificial light, downrange operations must halt in time to permit personnel and equipment to exit the Exclusion Zone and proceed through decontamination before dusk. Conversely, operations shall not be begin until lighting is adequate.

11.8 Sanitation

Provisions have been made for sanitation facilities for the work force. At a minimum, the provision of toilet facilities shall meet the requirements of 29 CFR 1910.120(n), which includes one facility for less than 20 employees, or one toilet and one urinal for every 40 employees, up to 200; then one of each for every 50 employees. If it is a mobile crew *and* they have transport readily available, these requirements do not apply.

11.9 Excavation

Site excavations shall be shored or sloped to prevent accidental collapse, and otherwise conducted in accordance with 29 CFR 1926 (Subpart P). Under no circumstances shall site personnel enter excavations that are not adequately shored or sloped.

11.10 Fire Extinguisher

A fire extinguisher, ABC type, shall be available in the support zone.

11.11 Emergency Information

Emergency Telephone Numbers

Police/Fire Department	911
Hospital - ambulance: Arrange with Police/Fire	911
Fire Department	911
National Poison Control Center	(800) 682-9211
National Response Center	(800) 424-8802
Regional USEPA Emergency Response	(800) 424-8802
Chemical Manufacturers Association Chemical Referral Center	(800) 262-8200
Site Health & Safety Officer (Mr. Oliver Leek)	(781)-255-5554

Primary Source of Medical Attention

Facility Name: Newton Wellesley Hospital
Address: 2014 Washington Street, Newton, MA
Telephone: (617) 243-6193

Directions to Hospital: ….

1. Take right onto Watertown Street.
2. Newton Wellesley Hospital on left at intersection with Washington Street.

11.12 Emergency Signals

Because the work area covers relatively small extents, the primary emergency signal among site employees shall be by voice contact. All employees shall be trained in the following air horn signals:

HELP	three short blasts	(. . .)
EVACUATION	three long blasts	(- - -)
ALL CLEAR	alternating long and short	(-.-.-)

Fire/Explosion

Upon notification of a fire or explosion on-site, all personnel shall evacuate the site and the fire department shall be alerted.

Personal Protective Equipment Failure

If any site personnel experience a failure or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately leave the exclusion zone. Re-entry shall not be permitted until the equipment has been repaired or replaced.

Other Equipment Failure

If any other equipment on-site fails to operate properly, the SSHO shall be notified and then shall determine the effect of this failure on continuing operations on-site. If the failure affects the safety of on-site personnel or prevents completion of the tasks, all personnel shall leave the exclusion zone until the situation is evaluated and appropriate actions taken.

In all situations, when an on-site emergency results in evacuation of the exclusion zone, no personnel shall re-enter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The Site Safety Plan has been reviewed.
4. All site personnel have been briefed on any changes in the SSHP.

SECTION 12 - RECORDKEEPING, LOGS, AND REPORTS

12.1 General Requirements

All required records, logs, and forms shall be maintained according to the appropriate regulations. This includes all safety inspection reports, accident/incident reports, medical certifications, first aid/cpr, 40 hour training, 8-hour refresher training, 8-hour supervisor training, hazard communication training, monitoring results, etc. All exposure and medical monitoring records shall be maintained to OSHA 29 CFR 1910 and 29 CFR 1926.

STANDARD OPERATING PROCEDURE NUMBER 1
Personal Protective Equipment Program

Standard Operating Procedure
Personal Protective Equipment Program

I. PURPOSE

To provide minimum requirements for protection of employees, visitors and contractors from injury or ill health through the proper selection and use of Personal Protective Equipment (PPE).

II. PROGRAM RESPONSIBILITIES

A. The Site Safety and Health Officer is the personal protective equipment administrator and has the responsibility to:

1. Coordinate the program.

2. Ensure that annual training is conducted.

3. Review the program annually.

B. Supervisors are responsible for informing workers of the personal protective equipment requirements within their department/area. The supervisor shall also ensure that workers have been instructed in the proper donning, wearing, removal, and the cleaning or disposal procedures for such equipment, and that the worker has understood the instructions. The supervisor shall provide additional instructions as needed and shall strictly enforce site rules related to PPE use.

C. Workers are responsible for properly donning, wearing, removing, cleaning, and disposing of the required protective equipment.

D. The Site Health and Safety Officer (SSHO) is responsible for ensuring that Contractors provide their own protective equipment as specified in this Program.

E. The SSHO is responsible for maintaining the site PPE inventory control program.

F. The Project Manager and SSHO are responsible for the purchase of PPE, including respiratory protection.

III. GENERAL REQUIREMENTS

A. Employees shall only use personal protective equipment supplied by the company.

B. Visitors shall be supplied with the following personal protective equipment as outlined in the visitor safety policy.

Other Visitors - Hard hats and safety glasses (other PPE to be provided by employer).

C. Personal protective equipment requirements are posted in the site specific Health and Safety Plan.

D. Disposal of PPE and cleaning of reusable PPE is governed by the procedures specified in the Respirator Program.

E. Written procedures governing the safe use of PPE that might be required in an emergency are contained in this Standard Operating Procedure. These plans also contain the training requirements for emergency PPE.

IV. CHEMICAL PROTECTIVE CLOTHING

A. Selection of Chemical Protective Clothing (CPC) shall be based on the following:

1. Manufacturers' instructions and degradation, penetration and permeation data

2. Published literature such as the ACGIH Guidelines for the Selection of Chemical Protective Clothing

3. Selected clothing shall be contained in the Site Safety and Health Plan (SSHP)

V. PPE INSPECTION

A. Respirators shall be inspected in accordance with the Respiratory Protection Program.

B. Other PPE should be inspected prior to use by the wearer. Inspection considerations shall give attention to obvious signs of contamination, tears and holes, proper function of closures, seams, etc. Sample PPE inspection checklists are found in Standard Operating Procedure 2.

C. PPE stored for emergency use should be inspected monthly.

VI. STORAGE

Storage of PPE at the site shall be performed in accordance with the following general guidelines:

A. Boots shall be decontaminated and stored on a boot rack at the hot line to dry.

B. Disposable protective clothing may be stored before use at the hot line. However, a covering or other method should be provided to prevent contamination. Disposable clothing articles are placed in waste containers at the hot line after being removed. Disposable clothing is not to be reused.

C. Respirators are stored in accordance with the Respiratory Protection Program. They should not be stored in the open air in contaminated areas.

D. Reusable PPE should be stored in accordance with manufacturer's instructions to prevent equipment failure.

E. Potentially contaminated coveralls worn under disposable coveralls shall be stored in containers in a separate area from street clothing.

VII. WORK MISSION DURATION

Since the work mission durations vary by site and task, it shall be the responsibility of the Project Manager and the SSHO to maintain adequate supplies of PPE and breathing air to accomplish the work mission and comply with this program.

STANDARD OPERATING PROCEDURE NUMBER 2

Respiratory Protection Program

AIR PURIFYING RESPIRATORY PROTECTION

RESPIRATOR TRAINING OUTLINE

A. Training of respirator wearers in the use, field maintenance, capabilities, and limitations of respirators is given initially upon employment to all employees whose work shall require the use of respirators, or where an employee changes into a job classification that requires respiratory protection. Retraining is given at least annually thereafter. No employee is allowed to wear a respirator in a work situation until he or she has been trained.

B. Each employee's training shall have included the following:

1. Instruction in the nature of the respiratory hazards, and what may happen if the respirator is not used properly.

2. An explanation of the engineering and administrative control measures being used and why respirators are needed to provide protection.

3. Instruction in the selection, use, sanitary care, maintenance, proper storage, and limitations of each applicable respirator type.

4. Demonstrations and practice in proper fitting, wearing, adjusting, and checking the face-to-face piece seal of each applicable respiratory type.

5. An opportunity to handle the respirator and to wear it in a safe atmosphere for an adequate period of time to ensure familiarity with the characteristics of the respirator.

6. An opportunity to wear the respirator in a test atmosphere (such as atmospheres generated by smoke tubes or isoamyl acetate) to demonstrate that the respirator protects the worker.

7. Instructions in how to recognize and cope with emergency situations requiring respiratory protection.

8. An explanation of the requirement for a self-contained breathing device for work in unknown concentrations and immediately dangerous to life or health (IDLH) atmospheres, and for fire fighting.

9. An explanation of the medical surveillance program as it relates to the use of respiratory protective equipment.

10. An explanation of the requirements for maintaining the respirator gas-tight seal, including beard and facial hair policies; and the policy prohibiting the use of contact lenses while wearing respirators.

C. Records of the training undergone by each individual are placed in the employees training record file.

Respirator Fit Test Form

Employee Name: _____

Respirator Type (1)

Face Piece (2)

Make, Model

Size

Cartridge Used

Test (3)

Normal Breathing

Deep Breathing

Side to Side

Up and Down

Speaking

Bending

Jogging

Normal Breathing

Sensitive to Smoke

Pass (P)/Fail (F)

Comments: _____

_____

Person Conducting Fit Test: _____

Date: _____

(1) Respirator Type: AP (air purifying); SA/SCBA (supplied air with SCBA escape bottle); SCBA (self-contained breathing apparatus
(2) Face Piece: F (full face); H (half mask)
(3) Test: IS (irritant smoke); QN (quantitative)

Monthly Written Respiratory Protection Program Evaluation

11 Points of 29 CFR 1910.134

___ 1. There are written standard operating procedures governing the selection and use of respirators.

___ 2. Respirators are selected on the basis of hazards to which the worker is exposed.

___ 3. Approved or accepted respirators are used when they are available.

___ 4. The user is instructed and trained in the proper use of respirators and their limitations.

___ 5. Where practical, the respirators are assigned to individual workers for their exclusive use.

___ 6. There are regular inspection and evaluations to determine the continued effectiveness of the program.

___ 7. Persons shall not be assigned to tasks requiring the use of respirators unless it has been determined that they are physically able to perform the work and use the equipment; i.e., medically qualified.

___ 8. Respirators shall be regularly cleaned and disinfected.

___ 9. Respirators shall be stored in a convenient, clean and sanitary location.

___ 10. Respirators used routinely shall be inspected during cleaning.

___ 11. Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.

Reviewed by: _____ Date of Review: _____

SELF-CONTAINED BREATHING APPARATUS

DONNING AND DOFFING SCBA

Donning breathing apparatus from wall mount

1. Open canvas bag to expose equipment.
2. Open cylinder valve fully, check pressure; if less than 1,500 psi, change cylinder or get another mask.
3. Check pressure on regulator; if more than 400 psi difference between cylinder pressure and regulator pressure, change cylinder or get another mask. (Report condition.)
4. Back up to equipment, insert both arms into the harness and fasten securely adjusting shoulder straps.
5. Walk away from mounting rack to disengage the equipment and prepare to don facepiece.

Donning breathing apparatus using overhead method.

1. Remove case from apparatus.
2. Lay case on ground so you are facing fire building when donning mask.
3. Open case, remove facepiece, put aside.
4. Remove helmet from your head, put aside.
5. Raise cylinder neck and open valve fully, check pressure on gauge, if less than 1,500 psi, change cylinder or get another mask.
6. Check pressure on regulator; if there is more than 400 psi difference between cylinder pressure and regulator pressure, change cylinder or get another mask.
7. Lay apparatus flat again.
8. Grasp the backplate in a convenient manner with one hand on each side of the plate in preparation to lifting the equipment from the case.
9. Lift the equipment from the case and permit the demand regulator and harness to hang freely.
10. Raise cylinder overhead and permit elbows to find their respective harness shoulder strap loops.
11. Continue to carry the cylinder overhead toward the back where it can be released to the back.
12. Lean forward when the cylinder is released so that the cylinder shall not slide down the back. Fasten and adjust the upper chest strap to hold the demand regulator in position.
13. With both hands on their respective sides, grasp the two harness take-up straps located near the chest, just below the armpits, and pull down and tighten the equipment firmly to the back.
14. Fasten and adjust the low waist straps which shall conclude harness adjustment to secure the equipment to the body.

Donning the back strap model (coat method)

There is a certain degree of preparation that needs to be done to the harness of the back strap model before equipment is lifted from the case. There are two shoulder straps on this model and one strap supports the demand regulator. The harness should be arranged so that this shoulder strap and regulator can be used to lift the breathing equipment.

1. With the right hand, palm up, grasp the shoulder strap that supports the demand regulator, about midway between the regulator and cylinder, and lift the equipment from its case so that the cylinder control valve points downward.
2. Lift the equipment up along the left side of the body raising the right hand and arm toward the left shoulder. At the same time, run the left arm through the loop that is formed by the harness and cylinder, then grasp the cylinder control valve with the left hand.
3. Continue to hold the cylinder control valve with the left hand in order to stabilize the weight of the cylinder and reach back with the right hand and arm for the right shoulder strap, similar to putting on a coat. Boost the cylinder into position on the back.
4. Fasten and adjust the top chest strap while slightly bent forward to secure the cylinder to the back and to hold the demand regulator in position.

5. With both hands, on their respective sides, grasp the two harness take-up straps located near the chest, just below the armpits, and pull down and out to tighten the equipment firmly to the back.
6. Fasten and adjust the lower waist strap which shall conclude harness adjustment to secure the equipment to the body.
7. The breathing tube can be connected to the regulator any time the wearer desires.
8. The minute the connection is made to the demand regulator, the wearer breathes from the cylinder.

(Source: IFSTA Manual #108)

CARE, INSPECTION AND MAINTENANCE OF SCBA

Cleaning the apparatus after each use

Cleaning the Pack

1. Remove cylinder from carrying case and detach high pressure hose from cylinder; remove cylinder from harness.
2. Slide regulator loop assembly off strap. Lay regulator assembly carefully aside.
3. With warm detergent, or soap and water solution, wash entire equipment (except regulator and alarm). Rinse with clean water and hang to air dry.
4. To clean regulator assembly and alarm, protect opening with thumb and use clean damp rag or sponge.
5. Carrying case should be thoroughly cleaned. Dirt left in the case shall find its way into facepiece and regulator openings.

Cleaning the Facepiece

A. Equipment Required:
   1. Pail of warm water not to exceed 100^{o} F with a mild disinfectant solution.
   2. Pail of clean water not to exceed 100^{o} F for rinsing.
   3. A sponge and soft, lint-free cloth for washing.

B. Cleaning Procedure:
   1. Rinse facepiece under faucet or with hose (to remove loose dirt and foreign material).
   2. Scrub mask portion, inside and out, with a sponge saturated with solution. Clean lens with a soft cloth or sponge.
   3. Hold facepiece by the end harness and submerge the inhalation tube and the exhalation valve in the disinfectant solution. Remove from solution.
   4. Remove protective cap from exhalation valve. With corner of sponge, gently lift and clean under the edge of the rubber valve.
   5. Replace protective cap. Submerge the facepiece in clear water to rinse.
   6. Dry the facepiece with a clean, lint-free cloth.

Inspection

AFTER EACH USE

After use, equipment should be inspected as follows (in addition to daily check):

A. Pressure on gauge - if less than 1,500 psi, replace or recharge.
   1. Harness and fitting sound.
   2. Screws in regulator assembly in position and tight.
   3. Bezel rings on pressure gauge tight.
   4. Disinfect facepiece.
   5. Clean entire unit.

B. Checking breathing apparatus if in safe condition for use (once a week or as often as possible).
   1. Check cylinder pressure - if less than 1,500 psi, change cylinder or get another mask.

2. Turn cylinder on fully, check regulator pressure; if more than 200 psi difference, report defect.
3. Check facepiece and hose by inhaling slowly with the thumb over the end of the hose connection; facepiece should collapse against face; if not, there is a poor fit or a leak.
4. Check exhalation valve - remove thumb from end of hose connection, take a deep breath, place thumb over the end of hose connection, exhale. Air should go out through exhalation valve. If it goes out side of facepiece, exhalation valve is defective.
5. Check harness straps, look for worn or broken straps, all straps extended to tab at buckle.
6. Main line valve (yellow knob) should be fully opened and locked (if a locking device is provided).
7. By-pass valve (red valve) should be in closed position.
8. Connect facepiece hose to regulator, take a few breaths to check regulator.
9. Check alarm bell - open cylinder valve to put pressure on the regulator (close the tank valve, breathe the air pressure of the regulator slowly; the alarm should sound when you have reduced the pressure in the regulator to approximately 400 psi).
10. Check facepiece.
    a. Cleanliness
    b. Threaded fittings for damaged threads and possible obstructions.
    c. Head harness straps - check for worn or broken straps and buckles.
    d. Check lens for cracks.
    e. All harness straps are extended to the tab at the buckle.
    f. When putting facepiece back in box, the head harness should be reversed over mask portion of facepiece in readiness to don and inhalation tube is curled correctly and is not pinched or kinked when the lid of storage box is closed.

SCHEDULED INSPECTIONS

The following inspection procedures should be performed *daily* if possible. If not possible to inspect daily, then *at least* once a week.

1. Proper assembly and position of mask and facepiece in case.
2. Straps of facepiece and harness are fully loosened and lens intact.
3. Open tank valve to charge unit. Close tank valve.
4. Check pressure in unit. Replace or recharge unit if below 1,500 psi.
5. Listen for leaks.
6. Check position of valves on regulator. Operating (mainline) valve fully open and locked, emergency valve (by-pass) closed.
7. Breathe pressure off unit. (Do not use by-pass valve.) Note operation of regulator. Note operation of alarm bell.
8. Proper condition of inhalation tube. Visual check, by stretching tube, for breaks and punctures.
9. Cleanliness of mask case.
10. Thorough cleanliness of all parts.

SCBA INSPECTION CHECKLIST

SCBA Harness # _____ Tank # _____

Location _____

Next Hydrostatic Test Date _____

	OK	FAIL	DATE/INITIALS
1.	MASK - check for distortion, dirt, tears, age cracks, water moisture		
2.	MASK STRAPS - check for broken or missing buckles, tabs, tears, age cracks		
3.	MASK LENS - check for cracks, scratches, attachment fasteners		
4.	MASK EXHALATION VALVE - check for moisture, cleanliness, ease of exhalation		
5.	BREATHING TUBE - check for age cracks, holes, loose or missing fittings, do leak test		
6.	REGULATOR - check for missing or loose parts, screws, dirt, moisture		
7.	REGULATOR DIAPHRAGM - check by gently blowing into breathing tube connection		
8.	REGULATOR GAUGE - check for damage, leaks, within 200 psi of tank gauge?		
9.	MAIN AND BY-PASS VALVES - test operation, leaks, damage, not jammed open-closed		
10.	REGULATOR BREATHING TUBE CONNECTOR "O" ring, threads, dirt		
11.	ALARM BELL - test operation at 25% full tank pressure		
12.	HI-PRESSURE HOSE - cuts and severe abrasion, leaks under pressure, bubbles or swelling		
13.	HI-PRESSURE HOSE CONNECTOR - seal missing or damaged, thread damage, leaks under pressure		
14.	CYLINDER TANK - Hydro-test date, tank full, surface damage, dents or gouges		
15.	CYLINDER VALVE AND GAUGE - damage or leaks, valve seat bent, gauge within 200 psi of regulator?		
16.	CYLINDER BACKPLATE LATCH - tank secure, damage or loose		
17.	HARNESS STRAPS - correctly installed, worn, loose, cut, abrasion, clean		
18.	HARNESS HARDWARE - broken buckles, latches in place and functional		
19.	SCBA FULL OPERATIONAL TEST - don unit and fully test		

List any maintenance performed on unit and date: _____

General Maintenance

1. Cylinder hand wheel must be tight. Check allen screw or pin.
2. Threads on cylinder valve, if exposed, must be protected, preferably with a plastic cap supplied as original equipment.
3. Cylinders should never be picked up or carried by cylinder hand wheel. Proper manner is with neck of cylinder between fingers at a point below the cylinder gauge.
4. Caution in handling cylinders should always be practiced. A sharp blow or fall can damage the cylinder, cause damage to valve threads, or blow the fusible plugs.
5. Store wrench, supplied with apparatus in proper place in case.
6. Repairs to regulator or alarm assemblies should be made by authorized mechanics. However, this should not prevent members from performing general maintenance, such as tightening screws, nuts, and cylinder packing nuts.

Replacing Cylinders

When in quarters and it is noted that the cylinder pressure is less than 1,500 psi, cylinders should be removed from the apparatus and replaced by a fully charged spare cylinder. When the change is made, the assembly should be placed on another member and adjusted so that the regulator fits flat against the chest and the high pressure hose is as close to the wearer as possible (to prevent snagging). **Never leave** the valve open even if the cylinder is empty. Leaving the valve open tends to ventilate interior with atmospheric air and thus introduces moisture which could cause rust inside the cylinder. When replacing cylinders in the mask assembly, the following steps should be used:

1. Remove high pressure hose from cylinder valve.
2. Release backplate lever handle on band holding cylinder.
3. Lift cylinder up and out of backplate band.
4. Replace cylinder by reversing above procedure. In addition, while tightening backplate lever, hold cylinder slightly above cylinder wheel guard and point cylinder valve opening toward left hip side of backplate. Cylinder hand wheel should be positioned high enough above guard so the cylinder valve can be fully opened.
5. When replacing cylinder during fire operations, always work in fresh air by leaving contaminated or fire area.

Care and inspection of cylinders: After two and one-half years, the regulator with regulator hose should be returned to the factory or representative for test. Each cylinder is stamped with the month and year of manufacture and the date of the last test. After each five-year period, these cylinders should be hydrostatically tested. This procedure is necessary to meet requirements of the Department of Transportation.

Methods of Filling Small Cylinders

When self-contained breathing equipment is used infrequently, it may be safer and more economical to keep on hand extra filled cylinders so that a change can be made when needed. Empty cylinders can then be sent to a refilling station with complete safety. If, however, this type of equipment is frequently used, either in training or during firefighting, it is a distinct advantage to maintain a rigid cylinder inspection and provide a recharging system within the department. High pressure compressor units are sometimes maintained and operated by a local fire department. This type compressor differs from the usual service station low-pressure compressor, since these high-pressure compressors use water or soap and water lubrication, and all connections and tubing are high-pressure fittings. The quality of the compressed air should be checked periodically to conform with Compressed Gas Association Standard in GAS Pamphlet G-7.

STANDARD OPERATING PROCEDURE NUMBER 3

First Aid

IDENTIFICATION AND TREATMENT OF HEAT EXHAUSTION OR HEAT STROKE

1. **Heat Exhaustion**

A. Symptoms: Usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, his skin is clammy, and he may perspire profusely. The pulse is weak and fast, breathing is shallow. The victim may faint unless he lies down. This may pass, but sometimes it persists and, while heat exhaustion is generally not considered life-threatening, death could occur.

B. First Aid: Immediately remove the victim to the decontamination area in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock. (Make the victim lie down, raise feet 6-12 inches, maintain body temperature but loosen all clothing.) If the victim is conscious, it may be helpful to give sips of water. Transport victim to a medical facility.

2. **Heat Stroke**

A. Symptoms: This is the most serious of heat casualties due to the fact that the body excessively overheats. Body temperatures often are between 107-110^{o} F. The victim shall have a red face and may not be breathing. First there is often pain in the head, dizziness, nausea, depression, and a dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack shall usually occur suddenly. Heat stroke is *always* serious.

B. First Aid: Immediately evacuate the victim to a cool and shady area in the Decontamination Reduction Zone. Remove all protective outer wear and all personal clothing. Lay the victim on his back so that the head and shoulders are slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels, ice bags, etc., to the head and groin. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place in a tub of cool water. The main objective is to cool without chilling. Give no stimulants. Transport the victim to a medical facility as soon as possible.

IDENTIFICATION AND TREATMENT OF FROSTBITE

Frostbite is a localized injury, resulting from a freezing of tissue. It is most common to the fingers and toes due to reduced circulation in the extremities and on the face and ears as they are most commonly exposed (uncovered) to the weather.

For frostbite to occur, there must be subfreezing temperatures. It is most prevalent in very cold temperatures or when cold temperatures are extenuated by the wind (wind chill).

A. Symptoms

1. Pre-Frostbite - Affected area feels painfully cold, but usually flushed (red-rosy) in color.

2. First Degree Frostbite (frost nip - Crystallization in superficial tissues. Affected area no longer feels cold, and is completely numb. Skin coloration is a small white or grayish-yellow waxy patch. Immediate treatment shall completely reverse the condition with no ill effects.

3. Second Degree (Deep) Frostbite - A deep freezing of the fluids in the underlying soft tissues. Symptoms and treatment are the same as for above. Usually results in a death of tissue, blistering, black skin, loss of toes, etc., with possible complications from gangrene.

B. First Aid

1. Cover and protect the affected part
2. Provide extra clothes
3. Bring indoors as soon as possible
4. Give warm drink
5. Rewarm frozen part quickly by immersing in warm water (if thawed and refrozen, warm at room temperature)
6. Do not rub - causes tissue death
7. Do not apply direct heat
8. Do not break blisters
9. Do not allow to walk after feet thaw
10. Discontinue warming as soon as part becomes flushed
11. Exercise thawed part
12. Separate fingers and toes with sterile gauze
13. Elevate frostbitten parts
14. Seek medical attention because of chance of infection, or gangrene.

C. Treatment

For all frostbite - rapid rewarming (thawing) as soon and as quickly as possible is the preferred treatment. Do not warm tissue that shall only be refrozen, or warm feet if they are to be walked upon. Second degree frostbite requires medical attention and the victim should not be re-exposed to the cold.

D. Prevention

1. Fatigue, cigarettes, alcohol, lack of food and drink, clothing which restricts circulation, and any other factors which reduce circulation shall contribute to frostbite.
2. Properly insulate all body parts. Extreme cold may require a face mask. Use insulated gloves and boots.
3. Winds and wetness shall accentuate frostbite. Keep dry and do not expose skin to the wind.
4. Be observant of each other. Look at ears, rosy cheeks, etc. Often the victim does not realize he has frostbite.

IDENTIFICATION AND TREATMENT OF HYPOTHERMIA

Hypothermia is a systematic lowering of the body temperature. Extreme cases (core temperature below 90^{o} F) result in death of the victim. Hypothermia is the most common cause of death for persons involved in outdoor wilderness sport activities. It does not require freezing temperatures and, in fact, can occur in ambient temperatures as high as 70^{o} F. Wind and wetness greatly accentuate hypothermia due to the enhanced cooling. Typical hypothermia conditions are a rainy, windy day with 50^{o} F air temperatures.

A. Symptoms

1. First Stage: goose bumps, shivering, feeling chilly

2. Second Stage: violent shivering, blue lips, pale complexion, feeling extremely cold

3. Third Stage: victim *no longer feels cold*, lack of coordination, mild unresponsiveness, drowsiness, stumbling

4. Fourth Stage: failing eyesight, victim barely responsive, cannot speak, barely able to or cannot walk.

5. Fifth Stage: coma and rapid death

B. Treatment

For all levels - remove wet, frozen or restrictive clothing. Dry the victim. Rewarming should be via an external heat source which completely envelopes the victim - a warm vehicle, a warm room, a sauna, a tub of warm water, by placing the victim in a sleeping bag with another person(s), etc. - and not a source of radiant heat which shall warm only one side of the victim. Be prepared to administer CPR. Do not give the victim alcohol.

1. First Stage: Put on hat, shirt, additional clothing, wind breaker, etc. Eat and drink. Exercise on tense muscles.

2. Second Stage: Same as above, only more so. Warm drinks and rewarm if possible.

   NOTE: In hypothermia beyond second stage, the victim can no longer warm himself and must have an external heat source.

3. Third Stage: Rewarming, warm food and drink.

4. Fourth Stage: Remove wet or cold clothing and gradually rewarm victim so that blood trapped in extremities is rewarmed before it is circulated back into inner body to prevent afterdrop. Afterdrop is a further lowering of the body core temperature which results from recirculation of cold blood. Avoid hot, radiant heat sources which shall warm surface blood before inner blood has been warmed. Do not give warm drinks which fool the body internally into feeling it is warm. Fourth stage hypothermia victims are best treated by supervised, experienced medical help, as complications can cause death. Place victim in warm vehicle and evacuate immediately to a medical facility.

5. Fifth Stage: Gradual rewarming, but requires sophisticated medical help to prevent death from after shock (a recirculation of chilled blood causing heart fibrillation).

C. Prevention

1. Wear proper clothing which shall insulate the body, keep it dry and break the wind.

2. Cover the head, neck, wrists, and ankles in particular, as heat loss is most prevalent from these points.

3. Eat and drink warm fluids. Avoid eating snow.

4. Keep active to raise body temperature.

5. Avoid fatigue, alcohol, smoking and drugs.

6. Be aware of team members' condition and note symptoms.

STANDARD OPERATING PROCEDURE NUMBER 4

Confined Space Entry Policy

CONFINED SPACE ENTRY PROCEDURES

A. Confined Space Classification

Confined spaces are classified according to their existing or potential chemical and physical hazards. Classification is based on characteristics of the confined space, oxygen level, flammability, and toxicity. If any of the hazards present a situation that is immediately dangerous to life and health (IDLH), the confined space is classified as Class A. Classification is determined by the most hazardous condition of entering, working in, and exiting a confined space. Class B confined spaces have the potential for causing injury and illness, but are not IDLH. Class C entry is one in which the chemical hazard potential is minimal and does not require any special modification in work procedures.

B. Entry Procedures

Team Size - A minimum of three workers is required for each confined space activity (two entry and one standby; or one entry, one rescue, and one standby).

The one entry/one rescue/one standby arrangement should only be used when the confined space is relatively small and/or the entry person shall be in the line of sight at all times. In this instance, the rescue person acts as the second person in the "buddy system."

The two entry/one standby arrangement is used when the area of the confined space is larger, and the tasks may take the worker away from the entryway. Again, care must be taken with this arrangement because the standby person cannot enter the confined space and attempt rescue unless adequately protected (i.e., respiratory and dermal) and replaced by another qualified standby person.

This number of workers is the minimum buddy for these activities and, in most cases, should only be used for relatively nonhazardous confined spaces. Additional crew may be needed if entering a Class A or B confined space. Additional crew could include rescue, decontamination, and line-of-sight personnel.

C. General Entry Procedures

The following steps must be taken when entering a confined space:

1. Inspect all pieces of equipment to ensure they are in good working order. DO NOT ENTER CONFINED SPACE WITH DEFECTIVE EQUIPMENT.

2. Conduct a background check to identify all potential hazards that may be encountered in the confined space. Determine if there is a potential for fire/explosion hazards, as well as a potential for a toxic or oxygen-deficient atmosphere.

3. Before entry, the atmosphere inside the confined space must be tested. An attempt should be made to test the atmosphere without opening the entryway (i.e., through a vent line or a small opening). If the entryway must be opened to test and only low levels are expected in the confined space, crack open entryway, test breathing zone first, and then test the confined space. If potentially high levels are expected in the breathing zone, respiratory protection should be worn prior to opening the entryway cover.

4. If explosive, toxic, or oxygen-deficient atmosphere is detected, purge or ventilate the confined space prior to entry. Retest the atmosphere three times at 5-minute intervals. A person can enter the confined space without respiratory protection only if all three test results are below the

Permissible Exposure Limit/Threshold Limit Value (PEL/TLV), 10 per cent of the LEL, and above 19.5 per cent oxygen (all three conditions must be met).

(NOTE: Any downward deflection of the readings on the oxygen meter from background (i.e., 20.9 per cent) should be viewed as a potential for an IDLH atmosphere. Unless contaminants are known to be nontoxic, do not enter the confined space without respiratory protection if the oxygen level is below background.)

5. Blank, block, or otherwise isolate, lockout, and tag all chemical, physical, and/or electrical hazards wherever possible.

6. If using an air-purifying respirator or if an IDLH and/or explosive atmosphere exists, air monitoring must be on a continuous basis. If respiratory protection is not used and there is potential for atmospheric conditions to change due to work practices or conditions, air monitoring should be done periodically. In all these cases, a 5-minute escape pack must be used.

7. Record all results of the tests for hazardous conditions including the location, time, date, weather (if applicable), and readings on the PID, combustible gas meter, oxygen deficiency meter, Drager tubes, and any other equipment.

8. Wear appropriate clothing for site conditions, as determined by the Site Safety and Health Officer (SSHO).

9. A safety belt or harness with lifeline must be worn if hazardous conditions exist, although good safety precautions dictate their use regardless of "existing" conditions. If the diameter of the entryway is less than 18 inches, the wrist-type harness must be used and special provisions made if a supplied air respirator is necessary.

10. One person (standby) must remain at the entryway at all times and must keep continuous contact with the person entering the confined space. Contact can be maintained by line-of-sight, listening for sounds, the safety line, and/or radio. The standby person must not enter the confined space unless another trained person is available to act as standby, and he/she is equipped with adequate respiratory and dermal protection. (In most cases, respiratory protection would be an airline respirator or SCBA.)

11. Do not smoke when working in or near confined spaces and do not take flash-lighted photographs when explosive gases are known or suspected to be present.

12. Do not rely on permanent ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect permanent ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable ladder of adequate height to reach 3 feet above opening or a rope ladder, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off, if possible; otherwise, it should be held in place by the standby person.

13. Do not work without adequate lighting. Use only "explosion-proof" lights or hand lamps.

14. The entry person must not remain in the confined space if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Many of the gases that cause the most problems are odorless, tasteless, and invisible.

D. MANHOLE/SEWER ENTRY

When preparing to enter a manhole/sewer, the following safety measures must be taken:

1. Inspect all pieces of equipment to ensure they are all in good working order. DO NOT ENTER CONFINED SPACE WITH DEFECTIVE EQUIPMENT.

2. Park the vehicle near the manhole (do NOT leave the vehicle running). If the manhole is in the street, it is best to park so as to detour oncoming traffic around the manhole. The vehicle's emergency flashers and portable yellow warning beacon must be ON. The vehicle serves as protection from oncoming traffic, can be used to store emergency equipment (e.g., SCBA and first aid kit), and can be used in an extreme emergency to slowly pull an injured person from the confined space if a tripod with hoist attachment is unavailable or inoperative.

3. Erect portable barricades or cones around the manhole and in front of the vehicle to see that traffic is adequately diverted and to prevent pedestrians from falling in. Reflective vests should be worn so that workers are visible to approaching traffic.

4. If there are openings large enough to admit sampling tubes, test for the presence of explosive and toxic gases before removing each manhole cover. Otherwise, raise one side of the cover using the cover hook or pick, prop it slightly open, and conduct the tests.

5. If toxic or explosive gases are detected in the sewer, report this immediately to the local Fire Department and/or Department of Public Works.

6. Record the results of tests for hazardous conditions, including location, manhole number (if applicable), time and date, weather (if applicable), and the readings on the PID, combustible gas meter, oxygen deficiency meter, and Drager tube.

7. Remove manhole covers with a cover hook or pick; do not improvise. Be careful of fingers and toes; the cover is usually heavy and difficult to handle. Unless the cover is extremely heavy, it is safer for only one worker to handle it.

8. Test the atmosphere; if a toxic, flammable, or oxygen-deficient atmosphere exists, ventilate the sewer. Depending on the hazard, ventilation can be accomplished in a variety of ways: for example, (1) remove and vent the adjoining upstream and downstream manhole covers, as soon as possible, and well in advance of entering the manhole (high hazard); and (2) vent the manhole in which entry shall occur (very low hazard). If a blower is used, it is desirable to establish a flow of air in the sewer, <u>in</u> one manhole and <u>out</u> another. Ensure that the air intake is well away from automobile exhaust, and combustible and/or toxic atmospheres. Appropriate traffic control measures must be taken by barricading or otherwise marking the open manholes.

9. After ventilating, test for explosive and toxic gases and oxygen deficiency in the manhole at ground level and at the bottom; record results. If entering the sewer itself, make the same tests at the manholes at either end. If ventilation is necessary, monitor the atmosphere in the manhole while work progresses, or continue operation of the blower. Continuous monitoring (i.e., equipment ON during entire entry) is imperative because conditions within the sewer may change rapidly. Do not enter a manhole while there is an oxygen deficiency without a pressure-demand, air-supplied breathing apparatus. If the oxygen level is lower than 20.9 per cent of background, caution must be taken because an IDLH atmosphere may exist.

10. When entering manholes or tanks, wear hardhats, protective clothing, and unless inappropriate, respiratory protection and safety belt or harness with lifeline. If the manhole is less than 18 inches in diameter, a wrist-type harness must be used and special provisions made if air-supplied respirators are necessary. When working in manholes greater than 12 feet deep, in the sewer itself, of where potential exists for gases to appear unexpectedly, a 5-minute emergency egress air supply is required (unless the time required to don the emergency respirator is greater than what would be needed to exit the manhole.)

11. At least one person (i.e., standby) must remain at the manhole at all times and must keep continuous contact with the person entering the sewer. Contact can be maintained by line-of-sight,

listening for sounds, and the safety line and/or radio. The standby person must not enter the manhole unless another trained person is available to act as standby and has adequate respiratory and dermal protection available. (in most cases, respiratory protection shall be an airline respirator or SCBA). The standby/rescue person should be suited up (but not yet on air) before the work crew enters the confined space.

12. Do not smoke when working in or near manholes. Do not take flash-lighted photographs when explosive gases are known or suspected to be present.

13. Do not rely on the manhole ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect manhole ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable or rope ladder of adequate height to reach 3 feet above the manhole opening, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off if possible; otherwise, it should be held in place by the standby person.

14. Do not work without adequate lighting. Use only "explosion-proof" lights or hand lamps in the manhole or sewer.

15. The entry person must not remain in the manhole or sewer if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Remember that carbon monoxide, carbon dioxide, methane, and hydrogen sulfide, which cause the most trouble, are odorless (hydrogen sulfide has a distinct odor only during initial exposure), tasteless, and invisible.

GEOTECHNICAL ENGINEERING REPORT
HORACE MANN ELEMENTARY SCHOOL
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EXECUTIVE SUMMARY

Ransom Consulting, Inc. (Ransom) has prepared this Geotechnical Engineering Report for Arrowstreet, Inc. (Arrowstreet) for the Horace Mann Elementary School, located at 687 Watertown Street, Newton, Massachusetts (the "Site"). This geotechnical report has been prepared in general accordance with our revised proposed scope of work dated April 8, 2019.

The Site includes a single parcel of land identified by the City of Newton as Property 21022 0001A and includes approximately 1.59 acres. A Site Location Map and Subsurface Exploration Plan are provided as Figures 1 and 2, respectively.

Ransom understands that construction is planned for the school including interior renovations, the removal of modular building additions, construction of a new parking area, construction of an entry plaza, and construction of underground stormwater management systems.

Six test borings were advanced in areas of proposed construction to depths of approximately 9 to 22 feet below the ground surface (bgs), corresponding to approximate elevations of 8 to 27 feet above Mean Sea Level (MSL). The test borings generally encountered surficial layers of asphalt, concrete, or topsoil, underlain by fill materials, a variable organic silt deposit, and a native sand layer. Fill materials were encountered in all of the borings underlying surficial layers extending to depths of 6 to 7 feet bgs. Groundwater was encountered in 4 of the 6 test borings at depths of approximately 7 to 13.5 feet bgs, corresponding to approximate elevations of 20 to 24 feet above MSL.

Groundwater was observed at a depth of approximately 9.5 feet bgs within the area of the proposed building entry plaza. Ransom has not been provided finalized designs for construction; however, we anticipate that groundwater may be encountered during excavation and construction of the entry plaza foundation elements and recommend the contractor be prepared to address groundwater encountered during construction.

The fill materials and organic deposit are unsuitable soils that should not be used to provide support to foundation elements and should be removed from within the proposed entry plaza footprint and foundation bearing zones. These soils could likely be left in place below parking areas with further evaluation by the project geotechnical engineer at the time of construction. The project Civil Engineer should evaluate the need to remove the unsuitable soils in areas planned for stormwater management systems. Excavation to remove and replace the unsuitable soils is anticipated to generally be less than 6 to 7 feet bgs.

Following excavation and replacement of the unsuitable soils with compacted structural fill where necessary, the proposed entry plaza construction could be supported on foundations bearing directly on the native sand soils or compacted structural fill placed above the undisturbed, inorganic, native sand soils. A maximum allowable contact pressure of 3,000 pounds per square foot (psf) should be proportioned for necessary foundations.

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1.0 INTRODUCTION

Ransom Consulting, Inc. (Ransom) has prepared this Geotechnical Engineering Report for Arrowstreet, Inc. (Arrowstreet) for the proposed renovations of the Horace Mann Elementary School property located at 687 Watertown Street, Newton, Massachusetts (the "Site"). This geotechnical report has been prepared in general accordance with our proposed scope of work titled "Proposed Scope of Work and Cost Estimate – Revision 1" dated April 8, 2019. The general location of the Site can be seen on Figure 1.

This geotechnical engineering evaluation was performed to obtain site-specific subsurface soil information and to make geotechnical evaluations and recommendations for the proposed renovations. As completed, Ransom's scope of services included the following items:

1. Subcontracting and coordinating with a drilling contractor and private utility locator, marking the Site for utility clearance, and contacting the Dig Safe utility clearance system as required by law.

2. Providing technical monitoring for the subsurface explorations, collecting soil samples, and preparing exploration logs.

3. Submitting selected soil samples for laboratory geotechnical soil testing.

4. Evaluating the field and laboratory data with respect to the proposed redevelopment and preparing this report of our findings, evaluations, and recommendations for the proposed design and construction.

2.0 SITE AND PROJECT DESCRIPTIONS

The Site is currently the location of the Horace Mann Elementary School and includes a single parcel of land located in Newton, Massachusetts. The parcel is identified by the City of Newton as Property 21022 0001A and consists of approximately 1.59 acres. A Site Location Map and Subsurface Exploration Plan are provided as Figures 1 and 2, respectively.

2.1 Existing Conditions

The Site is currently developed as the Horace Mann Elementary School with associated parking areas and recreation areas. The school is a two-story brick and concrete building with an additional lower (basement) level. The school building encompasses an approximate gross building area of 41,019 square feet. The school building was constructed in 1965. Two modular additions were added to southeastern and eastern portions of the building more recently.

Site topography generally slopes downward to the north and west with a stream channel, Cheese Cake Brook, just west of the western Site boundary. Based on the Newton, Massachusetts United States Geological Survey (USGS) 7.5-minute Quadrangle, and the "Existing Conditions Plan" provided by Nitsch Engineering, dated February 22, 2019, Site elevations vary from approximately 27 feet above Mean Sea Level (MSL) at the western Site boundary to approximately 37 feet above MSL at the southeastern corner of the Site.

2.2 Proposed Redevelopment

Ransom understands that the proposed Site renovations include interior renovations, removal of the modular building additions, construction of a new parking area, construction of a new entry plaza, and the construction of new stormwater management systems.

At the time of this report, a proposed grading plan had not been developed. Ransom assumes minor grade cuts and fills may be required for the construction of the additional parking area. Conceptual plans provided indicate that the lower level (basement) floor slab elevation is approximately 28.7 feet above MSL and the middle level is 36.7 feet above MSL. We understand that the entry plaza will be constructed at the approximate elevation of the existing lower level which will require a grade cut of approximately 2 to 3 feet.

3.0 SUBSURFACE INVESTIGATION

The geotechnical subsurface exploration program was conducted for the Site on April 16, 2019. The subsurface exploration program consisted of the advancement of six test borings, designated B101 through B104, B104A, and B105 as shown on Figure 2. The explorations were not surveyed; their locations and elevations should be considered approximate.

3.1 Subsurface Explorations

The test borings were performed by New England Boring Contractors of Derry, New Hampshire, with a track-mounted drill rig using a 2.75-inch inside-diameter, hollow-stem auger. Split barrel sampling with standard penetration testing (ASTM D 1586) was conducted using an automatic drive hammer continuously from the ground surface to depths of 6 to 10 feet below the ground surface (bgs) and at 5-foot intervals thereafter to the bottom of the borings or as advised by Ransom's field representative.

A Ransom representative monitored subsurface exploration activities, prepared boring logs, and measured the depths to groundwater. Soil samples were placed in sealed containers and returned to Ransom's office for further evaluation. Soil samples were visually classified using modified Burmister Soil Classification System descriptors. Exploration logs are included in Appendix A.

3.2 Laboratory Testing

The geotechnical soil index testing (grain-size distributions) was performed on select samples by ConTest Consultants, Inc. of Goffstown, New Hampshire; the laboratory report is included in Appendix B. The geotechnical laboratory tests were performed in general accordance with the applicable ASTM procedures.

3.3 Underground Utility Survey

Prior to conducting the subsurface explorations, Ransom coordinated an underground utility locating survey performed by TPI Environmental (TPI) to confirm the presence or absence of underground utilities in locations proposed for subsurface explorations. Ransom monitored the survey that was performed on April 9, 2019. The survey was completed by TPI using both ground-penetrating radar (GPR) and electromagnetic (EM) conductivity technologies. A sketch identifying the underground utilities identified at the Site is provided in Appendix C.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the Site were characterized by advancing test borings into the unconsolidated overburden soil formations at accessible locations at the Site. Figure 2 illustrates the existing Site features and approximate test boring locations.

4.1 Subsurface Soils

The test borings were advanced to depths of approximately 9 to 22 feet bgs corresponding to elevations of approximately 8 to 27 feet above Mean Sea Level (MSL). Subsurface explorations generally encountered surficial layers of asphalt, concrete, or topsoil, underlain by fill materials, variable organic silt, and a native sand layer. Fill materials were encountered in all of the borings underlying surficial layers to depths of 6 to 7 feet bgs.

The general characteristics of the subsurface layers are described below in order of increasing depth encountered below the ground surface.

Surficial Materials

Asphalt, observed to be approximately 3 inches thick, was encountered at the ground surface in borings B101 and B102. Concrete with wire-mesh reinforcement, which was observed to be approximately 5 inches thick, was encountered in boring B103.

A layer of topsoil was encountered in borings B104, B104A, and B105. The topsoil was observed to extend from the ground surface to a depth of approximately 2 feet bgs.

Fill Material

Fill materials consisting of brown, medium to fine-grained sand and silt was observed immediately underlying the surficial layers in all of the borings. This layer was typically present from approximately 0.2 to 2 feet bgs extending to depths of 6 to 7 feet bgs. The fill materials were observed to be present above the water table in each of the test borings and standard penetration tests indicated the fill materials were in a variable loose to dense condition. Portions of the fill materials were observed to contain a light organic odor and contain trace amounts of debris such as ash, coal, and wood. The composition of the fill material varies with depth and location; however, samples selected for laboratory analysis were determined to be silty sand with gravel (SM) in accordance with the Unified Soil Classification System (USCS).

Organic Silt

A layer of organic silt was observed in two of the test borings, B102 and B103. The organic silt layer was observed to consist of a fibrous moist dark brown silt, with little fine sand, and a light organic odor. This layer was observed immediately underlying the fill materials. Standard penetration testing indicated the organic silt layer to be in a loose condition.

Native Sand

A native sand layer was encountered in all of the borings (no sample recovered in B104 due to refusal within the suspected native sand layer). The native sand unit was observed to consist of a brown, fine to medium sand with little silt, and occasional trace amounts of gravel. This layer was encountered

underlying the fill materials and organic silt, at depths of 6 to 7 feet bgs extending to depths of 10 to 22 feet bgs. The native sand deposit was observed to be in a medium dense condition. Laboratory testing determined these soils to be well-graded sand with silt and gravel (SW-SM) in accordance with the USCS.

4.2 Drilling Refusal/Bedrock

Refusal, the depth at which the drilling equipment was not able to penetrate the deeper geologic formations was encountered in one of the test borings, B104, at a depth of 9 feet bgs. Ransom believes this refusal was likely caused by the presence of a large cobble, as abundant small cobbles were observed in the drill cuttings and a second boring, B104A, located approximately 6 feet to the east, was able to be advanced to a depth of 17 feet bgs.

4.3 Groundwater

Water-saturated soils and groundwater were encountered in 4 of the 6 test borings. Groundwater was generally observed at depths ranging from approximately 7 to 13.5 feet bgs, corresponding to approximate elevations of 20 to 24 feet above MSL.

Groundwater levels at the Site will fluctuate due to season, temperature, precipitation, nearby underground utilities, and construction activity. Therefore, water levels at other times may differ from the observations and measurements made during this evaluation.

5.0 ENGINEERING EVALUATIONS

The subsurface explorations encountered surficial layers of asphalt, concrete, or topsoil overlying fill materials, organic silt, and native sand. The controlling geotechnical features for the redevelopment of the Site are:

1. Foundation-Bearing Soils. The naturally-occurring sand deposit soils are considered the uppermost suitable bearing stratum for the proposed entry plaza. The proposed entry plaza could be supported on a conventional, shallow foundation system of spread and continuous footings that bear on the naturally-occurring sand deposit soils, or structural fill placed and properly compacted above these soils.

2. Unsuitable Soils. The fill materials and organic silt are considered unsuitable for providing support to the proposed building foundation elements. Unsuitable soils will require removal and replacement with compacted structural fill within the proposed entry plaza area. Unsuitable soils were generally encountered to depths of approximately 6 to 7 feet bgs. These soils could likely be left in place below parking areas provided that they are found to perform well during proof-rolling activities that should be conducted at the time of construction. The project Civil Engineer should evaluate the need to remove the unsuitable soils in areas planned for stormwater management systems.

3. Groundwater. Groundwater was observed at a depth of approximately 9.5 feet bgs within the area of the proposed entry plaza, corresponding to an approximate elevation of 20.5 feet above MSL. Groundwater may be encountered during excavation of unsuitable soils in the area of the proposed entry plaza.

Geotechnical engineering evaluations for this project are based on the subsurface conditions interpreted from widely spaced subsurface explorations, laboratory testing, and the project design information currently available. Should differing information become known prior to or during construction, the following evaluations and recommendations should be reviewed by Ransom and modifications to these recommendations may be necessary.

6.0 DESIGN RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, Ransom presents the following recommendations for the proposed construction at the Horace Mann Elementary School Site.

6.1 Building Foundations

The subsurface conditions generally consist of surficial layers of asphalt, concrete, or topsoil overlying fill materials, a variable organic silt layer, and a native sand deposit. The native sand deposit is considered the uppermost suitable bearing strata for foundation elements. Surficial layers, fill materials, and organic silt soils located within the footprint of the proposed entry plaza should be excavated and replaced with compacted structural fill. Excavation to remove and replace the unsuitable soils is anticipated to generally be less than 6 to 7 feet bgs (elevations 23 to 24 feet above MSL). With proper site preparation, the proposed entry plaza could be supported on foundations that bear directly on the native sand soils, or compacted structural fill placed above the undisturbed native sand deposit.

Foundation elements for the entry plaza should be proportioned using a maximum allowable contact pressure of 3,000 pounds per square foot (psf). Spread footings should be at least 2 feet wide and continuous footings should be at least 1.5 feet wide. Post-construction total and differential settlements are anticipated to be no more than approximately 1 inch and 0.5 inch respectively.

Lateral loads may be resisted by friction between the bottoms of footings and supporting subgrades, and by passive earth pressure against the sides of the foundation. A friction coefficient of 0.40 and an equivalent fluid unit weight of 200 pounds per cubic foot (pcf) against the sides of footings should be used.

Exterior footings should be placed a minimum of 4 feet below the lowest existing or proposed adjacent ground surface exposed to freezing. The proposed entry plaza is directly adjacent to the existing school building. To avoid adverse impacts on the existing building, any new foundation elements needed to support the entry plaza construction should be located outside the zone of influence of the existing building foundations. For this purpose, the zone of influence should be considered the zone beneath lines extending downward and outward at a slope of one horizontal to one vertical (1H:1V) from the outside edges of the footings. If new footings must be located near or within this zone, the need for possible underpinning of the existing foundations or other special construction considerations should be evaluated.

Conversely, if proposed foundation elements are located at a higher elevation than the existing building foundations, they could impose significant lateral loads on the existing foundation walls. We assume that the existing walls were not designed to resist these additional loads, and therefore, adjacent new footings will have to be lower than the existing building foundation walls to avoid application of additional lateral loads to the existing walls.

6.2 Floor Slabs

Fill materials and organic silt were encountered within the footprint of the proposed entry plaza. The fill materials and organic silt have the potential for non-uniform settlement that may exceed tolerable settlement limits. Fill materials and organic silt within the footprint of the proposed entry plaza should be excavated and replaced with compacted structural fill. Floor slabs should be underlain by a minimum of 12 inches of compacted structural fill. With proper Site preparation, conditions are suitable for a slab-on-grade ground floor. A modulus of subgrade reaction of 200 pounds per cubic inch (pci) should be used to proportion the slabs-on-grade constructed on properly compacted structural fill.

Exterior slabs at entrances should be underlain by at least 4 feet of free-draining material, such as structural fill or crushed stone, to reduce the potential for frost heaving. Surrounding grades should be sloped away from the building in order to reduce available moisture for forming frost and ice.

6.3 Seismic Considerations

For the purposes of seismic design, the soil profile constitutes a "stiff soil profile" and we assign a seismic site class of "D" to the Site. It is our opinion that the Site soils are not susceptible to liquefaction.

6.4 Groundwater and Drainage Issues

Water-saturated soils and groundwater were encountered in 4 of the 6 test borings. Groundwater was generally observed at depths ranging from approximately 7 to 13.5 feet bgs, corresponding to approximate elevations of 20 to 24 feet above MSL.

Groundwater was observed at a depth of approximately 9.5 feet bgs in the area of the proposed building entry plaza, corresponding to an elevation of approximately 20.5 feet above MSL. We assume that foundations necessary for the proposed entry plaza will bear at an elevation of approximately 24 feet above MSL. We do not anticipate groundwater at potential foundation elevations. However, groundwater may be encountered during excavation and construction of the entry plaza foundation elements. Water could likely be controlled by pumping from open sumps, as determined by the contractor.

It is our opinion that foundation drainage systems and/or vapor barriers are not necessary for the proposed entry plaza, based on geotechnical considerations. Ransom understands that Site soils and groundwater may be impacted by a historical petroleum release. Ransom has not evaluated the need for vapor barriers or other venting systems beyond geotechnical considerations. We recommend that the project architect in conjunction with the environmental professional for the Site evaluate these considerations with respect to the proposed construction.

7.0 EARTHWORK AND CONSTRUCTION RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, Ransom presents the following recommendations for the proposed construction at the Horace Mann Elementary School.

7.1 Subgrade Preparation

The surficial materials, fill materials, and organic silt soils are considered to be unsuitable for providing support to the proposed entry plaza. The native sand deposit soils are considered to be the uppermost suitable bearing strata for providing support to foundation elements.

All topsoil, unsuitable soils, debris, and loose or disturbed soils should be removed from below the entry plaza footprint and foundation bearing zones. These unsuitable materials should be completely removed from foundation bearing zones (to the lateral limits defined by a 1H:1V line sloped down and away from the bottom edge of foundations to the top of undisturbed native sand soils and replaced with compacted structural fill.

After site stripping has been completed, the subgrade beneath the building footprint and 10 feet beyond, parking lots, and driveways should be compacted with at least four complete passes of a 15-ton vibratory drum roller in directions perpendicular to one another. Silty subgrades which are saturated or are observed to pump and weave during rolling should be rolled statically.

Unstable subgrade areas would be characterized by weaving or rutting of more than one inch during proofrolling. Any unstable areas identified should be undercut at least 12 inches, or to competent soil, and replaced with compacted structural fill, crushed stone, or common fill. The depth of undercutting and type of backfill material should be selected with consideration of proposed use (i.e., building or pavement) and soil and weather conditions encountered during construction.

The contractor is responsible for construction means and methods and should anticipate the need for methods to prevent disturbance, softening, or rutting of subgrades, or damage to overlying soils resulting from construction traffic. Care must be taken to avoid disturbing subgrades by keeping construction traffic off of subgrades during wet conditions and/or inclement weather until a firm fill layer has been placed. Subgrade soils that become unstable should be undercut and replaced with structural fill, crushed stone or common fill, as necessary.

Final subgrade preparation should include re-compaction of bearing surfaces. Care should be taken to limit disturbance to bearing surfaces prior to placement of concrete. Any loose, softened, or disturbed material should be removed and replaced with compacted structural fill prior to placement of concrete. Excavated subgrades should not be left exposed overnight unless the forecast calls for above-freezing, clear conditions.

7.2 Temporary Excavations

Construction site safety means and methods, and sequencing of construction activities is the sole responsibility of the contractor. Under no circumstances should the following information be interpreted to mean that Ransom is assuming responsibility for construction site safety, trench protection, or the contractor's responsibilities. Such responsibility is not being implied and should not be inferred.

All temporary excavations should be performed according to Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1926 Subpart P). The fill materials and native sand are

considered OSHA Type C soils. Accordingly, temporary unbraced excavations should be cut no steeper than 1.5H:1V under dry or dewatered conditions.

7.3 Dewatering and Runoff Control

Groundwater was encountered within the borings at depths of approximately 7 to 13.5 feet bgs, corresponding to approximate elevations of 20 to 24 feet above MSL. Ransom anticipates that groundwater may be encountered during excavation and removal of the fill materials in the footprint of the proposed entry plaza. The contractor should be prepared to implement water controls as needed.

Surface water runoff should be directed away from excavations to reduce dewatering efforts and to protect subgrades from becoming soft and unstable. The contractor should anticipate the need for controlling runoff during wet periods.

Earthwork should be completed "in the dry" if possible. Subgrade soils that become unstable should be undercut and replaced with structural fill or crushed stone, as necessary. Excavation side slopes should be monitored for potential seepage and maintained to promote stability, accordingly.

Temporary detention ponds, trenches, ditches, and dewatering sumps should not be made in areas to be filled.

7.4 Placement of Granular Engineered Fills

Engineered fills will be required to achieve the final design grades in several areas of the proposed site redevelopment. The table below is the gradation specifications for soils to be used in engineered fills at the Site. Reference is made to materials described in the Massachusetts Highway Department (MHD) *Standard Specifications for Highways and Bridges*. The different granular fill types should be used as follows:

1. Structural Fill should be used for engineered fills below the entry plaza footprint area and in foundation bearing zones.

2. Common Fill should be used for engineered fills below roadway, parking, and other non-structural areas.

All granular fills should be placed in 12-inch maximum loose lifts and should be compacted to a minimum of 95 percent of the material's maximum dry density, as determined by ASTM D 1557 (modified Proctor test) and verified with field density testing (ASTM D 6938 or equivalent method). Lift thickness should be a maximum of 6-inch loose lifts when compacted with hand-guided equipment.

Where subgrades become saturated, unstable, and/or difficult to compact, crushed stone should be placed and compacted in lieu of structural fill. Crushed stone, when used, should be wrapped in a geotextile filter fabric, such as Mirafi 140N or equal. At no time should structural fill or common fill be placed over crushed stone that has not been wrapped in a geotextile filter fabric.

Type	Size	% Passing
Structural Fill; MHD M1.03.0a	6" (150 mm)	100
	1/2" (12.5 mm)	50–85
	No. 4 (4.75 µm)	40–75
	No. 50 (300 µm)	8–28
	No. 200 (75 µm)	0–10
Common Fill	8"	100
	No. 200 (75 µm)	0–15 (when placed within 4 feet of finished grade in paved areas)

7.5 Reuse of Site Soils

A preliminary assessment of the suitability of using the unconsolidated soils at the Site in the proposed construction is based on the soil classifications and observations at the Site. The suitability of these materials is summarized below. The project environmental professional should be consulted regarding potential environmental concerns with soil management during construction.

1. Topsoils are suitable only for reuse in landscaped areas.

2. The naturally occurring sands that will be excavated are suitable for reuse as common fill below non-structural areas and landscaped areas.

3. The existing fill materials that will be excavated might be suitable for reuse as common fill below non-structural areas and landscaped areas following additional evaluations, such as grain size analyses, at the time of construction.

Materials to be used as structural fill may need to be imported to the Site. Representative samples of all proposed fills should be submitted for testing during construction to compare their gradation characteristics to the requirements of the project specifications, and to establish their optimum water contents and maximum dry densities (modified Proctor testing, ASTM D 1557). The geotechnical engineer must approve use and reuse of on-site or borrow soils for structural and common fills. Use of fills assumes that the moisture content of the material will be strictly controlled in order to allow for proper placement and compaction.

7.6 Underground Utilities

Bedding placed below utilities should be in accordance with the utility and manufacturer requirements. In general, utilities may be supported directly on a minimum 6-inch-thick layer of compacted structural fill, crushed stone, or other suitable pipe bedding materials. Fill placed as backfill for utilities below building floor slabs should consist of compacted structural fill or crushed stone. Elsewhere, fill placed as backfill for utilities should consist of compacted common fill.

7.7 Construction Monitoring

Ransom should be provided the opportunity to review the final design and specifications to ensure our recommendations presented herein have been properly interpreted and applied. Ransom recommends that all fill, backfill, and compaction be inspected and tested by a qualified firm to make sure the proper materials are placed and adequately compacted. Ransom should review all soil inspection and testing

reports. Ransom should be retained to provide construction observation and documentation for the following aspects of site development:

1. Observe subgrade conditions as they are exposed and confirm that the exposed conditions are consistent with those in this report;

2. Observe and document the removal of unsuitable soils within the proposed building foundation bearing zones;

3. Determine the need for additional cut and backfill, or stabilization of subgrades; and

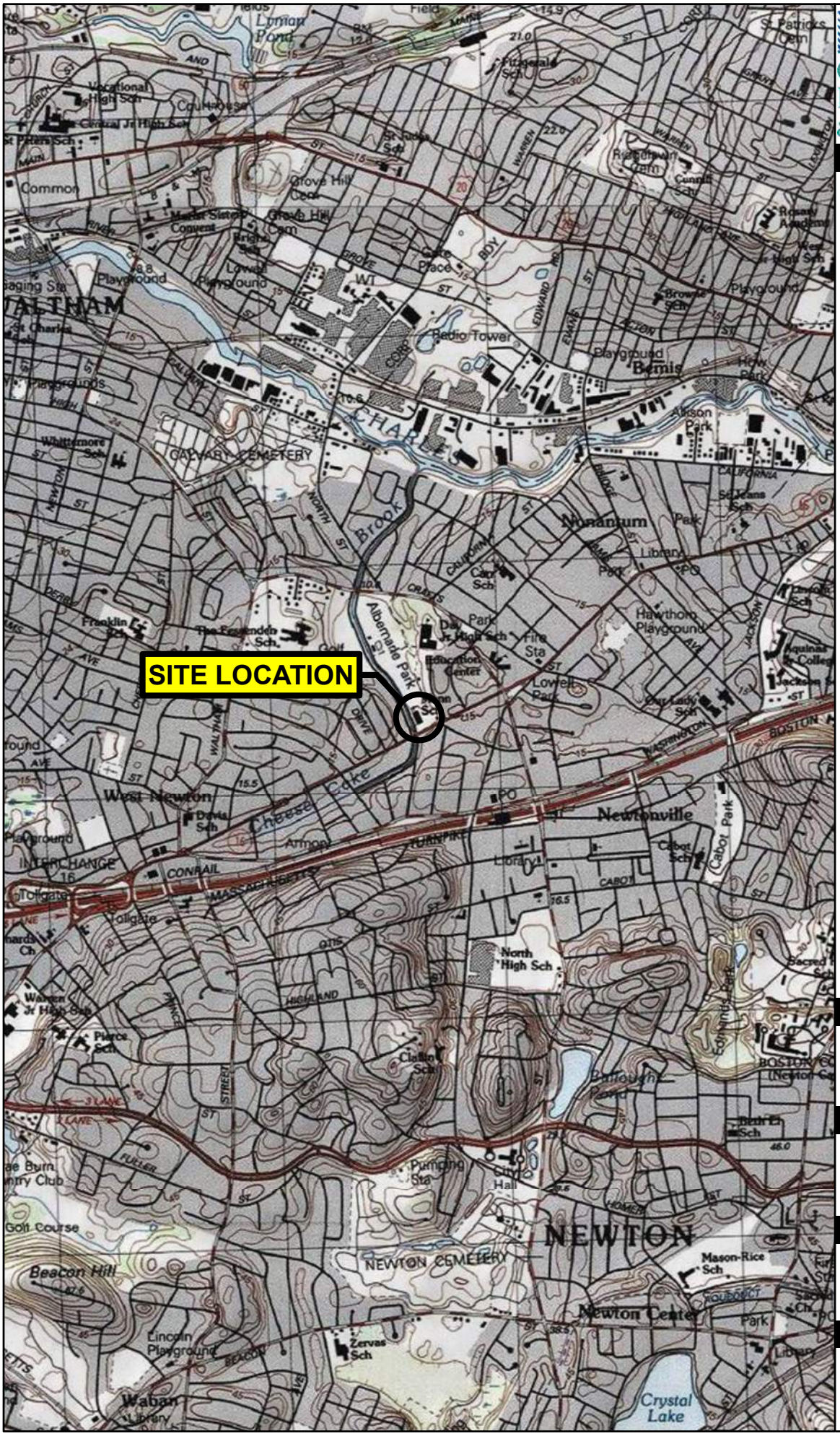
4. Document the preparation of foundation bearing surfaces and other subgrades.

8.0 CLOSING COMMENTS

This report has been prepared for specific application to the proposed construction at the Horace Mann Elementary School at 687 Watertown Street in Newton, Massachusetts as understood by Ransom at the time of this report. In the event that material changes in the design or location of the proposed structures are planned, the conclusions and recommendations contained in this report should not be considered valid unless they have been reviewed and modified or verified in writing by Ransom. Our recommendations are based in part upon data obtained from widely spaced explorations. The nature and extent of variations between explorations will not become evident until construction. If significant variations then appear, it may be necessary to reevaluate the recommendations of this report.

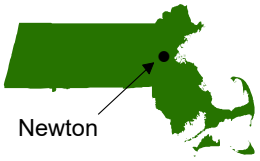
We recommend that Ransom be provided the opportunity to review the final design plans and project specifications in order to confirm that the recommendations made in this report were interpreted and implemented as intended.

The findings, recommendations, specifications, and professional opinions contained within this project geotechnical report have been prepared in accordance with generally accepted professional geotechnical engineering practice. No other warranties are implied or expressed.



RANSOM
Consulting Engineers and Scientists

Regional Locator Map



Notes

1. Data Source: 2013 National Geographic Society, i-cubed

2. USGS Quad Names:
Lexington and Newton, Massachusetts

3. Latitude: 42°21'17.1"N
Longitude: 71°11'48.4"W

Scale and Orientation

0 1,000 2,000

1 inch = 2,000 feet

Prepared For

Arrowstreet, Inc.
10 Post Office Square
Suite 700N
Boston, Massachusetts

Site Address

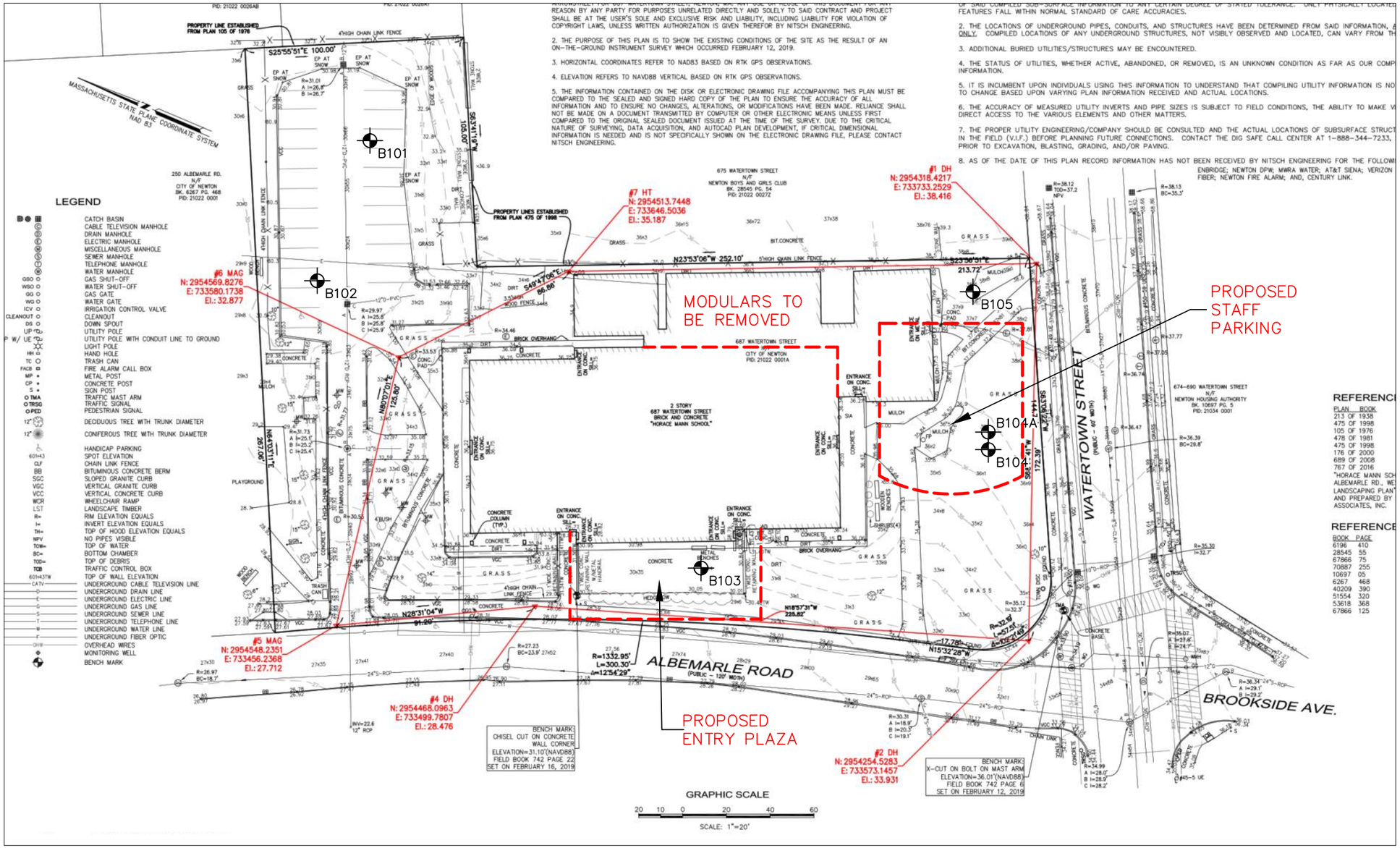
Horace Mann Elementary School
687 Watertown Street
Newton, Massachusetts

181.01063 | May 2019

Figure 1

Site Location Map

PM File: HMEC_Newton-MA-F1_SLM.mxd



LEGEND:

B101 SOIL BORING LOCATION

NOTES:

1. SITE PLAN BASED ON "EXISTING CONDITIONS PLAN" AS PREPARED BY NITSCH ENGINEERING DATED FEBRUARY 15, 2019. FIELD ACTIVITIES AND OBSERVATIONS PERFORMED BY RANSOM CONSULTING, INC. ON FEBRUARY 16, 2019.
2. SOME FEATURES ARE APPROXIMATE IN LOCATION AND SCALE.
3. THIS PLAN HAS BEEN PREPARED FOR ARROWSTREET, INC., ALL OTHER USES ARE NOT AUTHORIZED, UNLESS WRITTEN PERMISSION IS OBTAINED FROM RANSOM CONSULTING, INC.

0' 25' 50' 100'

SCALE in FEET
1"=50'

RANSOM Consulting, Inc.

PREPARED FOR:
ARROWSTREET, INC.
10 POST OFFICE SQUARE
SUITE 700N
BOSTON, MASSACHUSETTS

SITE:
HORACE MANN ELEMENTARY SCHOOL
687 WATERTOWN STREET
NEWTON, MASSACHUSETTS

SUBSURFACE EXPLORATION PLAN

DATE: MAY 2019
PROJECT: 181.01063.003
FIGURE: 2

W:\2018\181.01063\Geotech\Drafting\Subsurface Exploration Plan.dwg May 02, 2019 – 9:19am

APPENDIX A

Exploration Logs

Geotechnical Engineering Report
Horace Mann Elementary School
687 Watertown Street
Newton, Massachusetts

RANSOM
Consulting
Engineers
and Scientists

BORING LOG: B101

Reviewed by:	JPJ	Total Depth:	17 Feet	Logged By:	MJP
Date Reviewed:	4/16/19	Boring Diameter:	6 Inches	Date Drilled:	4/16/19 to 4/16/19
Surface Elevation (ft.):	31 +/-	Well Stickup:	NA	Driller:	NEBC

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	S1 (0-2') 3" ASPHALT, over 5" medium dense, light brown, fine SAND, trace fine gravel and silt, dry.	Sand (Fill)		S1	11-12-11-10	23	24/8	NA	
	S2 (2-4') Very dense, light gray, fine SAND and SILT, trace gravel, dry.	Sand and Silt (Fill)		S2	8-26-27-31	53	24/5	NA	
5	S3 (4-6') Dense, brown, coarse to fine SAND, little gravel and silt, moist/dry.	Sand (Fill)		S3	13-29-16-23	45	24/8	NA	
	Auger to 10'.								
10	S4 (10-12") Medium dense, brown, fine to medium SAND, little silt, wet.	Sand		S4	16-21-7-9	28	24/10	NA	
	Auger to 15'.								
15	S5 (15-17') Medium dense, brown, fine to medium SAND, trace silt, wet.	Sand		S5	33-13-8-7	21	24/6	NA	
	End of boring 17'.								
20									

WATER LEVELS:

During Drilling	End of Boring	Date:
<10'	8.5'	4/16/19

WELL LEGEND:

Filter Sand | Native Fill | Bentonite | Bentonite Grout | Concrete | PVC Screen | PVC Riser

NOTES:
1. Soil boring conducted using track-mounted drilling rig with hollow-stem augers.
2. Soil samples collected using 1 3/8" I.D. split-spoon sampler driven by 140 lb. hammer.
3. NA=not applicable; NM=not meaured; NE=not encountered.

CLIENT:
Arrowstreet, Inc.

SITE:
Horace Mann Elementary
687 Watertown Street
Newton, MA

Project No.: 181.01063 Page: 1

RANSOM
Consulting
Engineers
and Scientists

BORING LOG: B102

Reviewed by:	RJ	Total Depth:	10 Feet	Logged By:	MJP
Date Reviewed:	4/26/19	Boring Diameter:	6 Inches	Date Drilled:	4/16/19 to 4/16/19
Surface Elevation (ft.):	31 +/-	Well Stickup:	NA	Driller:	NEBC

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY		WELL CONSTRUCTION
	S1 (0-2') 3" ASPHALT, over 5" medium dense, light brown, medium to coarse SAND, some gravel, dry.	Sand (Fill)		S1	16-9-14-7	23	24/8	NA	
	S2 (2-4') Medium dense, light brown, medium to coarse SAND, some gravel, dry.	Sand (Fill)		S2	10-10-10-11	20	24/6	NA	
5	S3 (4-6') 3" Loose, light brown, medium to coarse SAND, some gravel, dry, over 3" loose, dark brown, organic SILT, little fine sand, moist.	Sand (Fill)/Organic Silt		S3	5-4-3-4	7	24/6	NA	
	S4 (6-8') 1" Loose, dark brown, organic SILT, little medium to fine sand moist, over 8" medium dense, brown/gray, fine to coarse SAND, little fine gravel, wet, orange staining at top 3".	Organic Silt/Sand		S4	10-12-9-11	21	24/9	NA	
	S5 (8-10') Medium dense, brown, fine to coarse SAND, little fine gravel, wet.	Sand		S5	9-14-15-18	29	24/12	NA	
10	End of boring 10'.								
15									
20									

WATER LEVELS:

During Drilling	End of Boring	Date:
~7'	7.3'	4/16/19

WELL LEGEND:

Filter Sand | Native Fill | Bentonite | Bentonite Grout | Concrete | PVC Screen | PVC Riser

NOTES:
1. Soil boring conducted using track-mounted drilling rig with hollow-stem augers.
2. Soil samples collected using 1 3/8" I.D. split-spoon sampler driven by 140 lb. hammer.
3. NA=not applicable; NM=not meaured; NE=not encountered.

CLIENT:
Arrowstreet, Inc.

SITE:
Horace Mann Elementary
687 Watertown Street
Newton, MA

Project No.: 181.01063 Page: 1

RANSOM
Consulting
Engineers
and Scientists

BORING LOG: B103

Reviewed by:	RD	Total Depth:	22 Feet	Logged By:	MJP
Date Reviewed:	4/26/19	Boring Diameter:	6 Inches	Date Drilled:	4/16/19 to 4/16/19
Surface Elevation (ft.):	30 +/-	Well Stickup:	NA	Driller:	NEBC

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	5" CONCRETE and WIRE MESH.								
	S1 (1-3') Loose, dark brown, fine SAND and SILT, trace fine gravel, moist, light organic content.	Sand and Silt (Fill)		S1	3-3-5-8	8	24/6	NA	
	S2 (3-5') Loose, dark brown/black, fine SAND and SILT, moist, light organic odor.	Sand and Silt (Fill)		S2	5-4-3-3	7	24/20	NA	
5	S3 (5-7') 8" Loose, dark brown, organic SILT, little fine sand, moist, fibrous peat, over 3" stiff, gray SILT, trace fine sand, moist.	Organic Silt/Silt		S3	3-3-6-17	9	24/5	NA	
	Auger to 10'.								
10	S4 (10-12') Medium dense, brown, fine to coarse SAND, little gravel, wet, beach sand.	Sand		S4	15-11-18-25	29	24/12	NA	
	Auger to 15'.								
15	S5 (15-17') Medium dense, brown, fine to coarse SAND, little silt, trace fine gravel, wet.	Sand		S5	7-11-14-9	25	24/12	NA	
	Auger to 20'.								
20	S6 (20-22') Medium dense, brown, fine to coarse SAND, little sitl, trace fine gravel, wet.	Sand		S6	15-15-17-22	32	24/4	NA	
	End of boring 22'.								

WATER LEVELS:

During Drilling	End of Boring	Date:
~10'	9.5'	4/16/19

WELL LEGEND:

Filter Sand | Native Fill | Bentonite | Bentonite Grout | Concrete | PVC Screen | PVC Riser

NOTES:
1. Soil boring conducted using track-mounted drilling rig with hollow-stem augers.
2. Soil samples collected using 1 3/8" I.D. split-spoon sampler driven by 140 lb. hammer.
3. NA=not applicable; NM=not meaured; NE=not encountered.

CLIENT:
Arrowstreet, Inc.

SITE:
Horace Mann Elementary
687 Watertown Street
Newton, MA

Project No.: 181.01063 Page: 1

RANSOM
Consulting
Engineers
and Scientists

BORING LOG: B104

Reviewed by:	JPJ	Total Depth:	9 Feet	Logged By:	MJP
Date Reviewed:	4/26/19	Boring Diameter:	6 Inches	Date Drilled:	4/16/19 to 4/16/19
Surface Elevation (ft.):	36 +/-	Well Stickup:	NA	Driller:	NEBC

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY		WELL CONSTRUCTION
	S1 (0-2') Loose, dark brown, fine to medium SAND, some silt, moist.	Loam		S1	3-3-4-5	7	24/8	NA	
	S2 (2-4') 6" Loose, brown/tan, medium to fine SAND, some debris (coal/ash), moist, over 10" medium dense, brown, medium to coarse SAND, little silt, gravel in shoe.	Sand (Fill)		S2	5-5-9-17	14	24/12	NA	
5	S3 (4-6') Medium dense, dark brown, fine to medium SAND and SILT, trace debris (brick), moist.	Sand (Fill)		S3	10-5-5-9	10	24/6	NA	
	Auger to 9'.								
	Auger refusal, end of boring 9'.								
10									
15									
20									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	4/16/19

WELL LEGEND:

Filter Sand | Native Fill | Bentonite | Bentonite Grout | Concrete | PVC Screen | PVC Riser

NOTES:
1. Soil boring conducted using track-mounted drilling rig with hollow-stem augers.
2. Soil samples collected using 1 3/8" I.D. split-spoon sampler driven by 140 lb. hammer.
3. NA=not applicable; NM=not meaured; NE=not encountered.

CLIENT:
Arrowstreet, Inc.

SITE:
Horace Mann Elementary
687 Watertown Street
Newton, MA

Project No.: 181.01063 Page: 1

RANSOM
Consulting Engineers and Scientists

BORING LOG: B104A

Reviewed by: JP		Total Depth:	17 Feet	Logged By:	MJP
Date Reviewed: 4/22/19		Boring Diameter:	6 Inches	Date Drilled:	4/16/19 to 4/16/19
Surface Elevation (ft.):	37 +/-	Well Stickup:	NA	Driller:	NEBC

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY	OVM (ppm) / DEXSIL (ppm)	WELL CONSTRUCTION
	Auger to 5'.								
5	S1 (5-7') 10" Dark brown, fine to medium SAND and SILT, trace debris (wood/brick), moist, over 6" light brown, fine to coarse SAND, little gravel and silt, moist.	Sand (Fill)		S1	5-7-11-13	18	24/16	NA	
10	S2 (10-12') Medium dense, light brown, fine SAND and SILT, moist. Difficult drilling 12 to 14', cobbles.	Sand and Silt		S2	19-19-14-18	33	24/15	NA	
15	S3 (15-17') Medium brown, medium to coarse SAND, little fine gravel, wet.	Sand		S3	12-13-14-20	27	24/15	NA	
	End of boring 17'.								
20									

WATER LEVELS:

During Drilling	End of Boring	Date:
15'	13.5'	4/16/19

WELL LEGEND:

Filter Sand | Native Fill | Bentonite | Bentonite Grout | Concrete | PVC Screen | PVC Riser

NOTES:
1. Soil boring conducted using track-mounted drilling rig with hollow-stem augers.
2. Soil samples collected using 1 3/8" I.D. split-spoon sampler driven by 140 lb. hammer.
3. NA=not applicable; NM=not meaured; NE=not encountered.

CLIENT:
Arrowstreet, Inc.

SITE:
Horace Mann Elementary
687 Watertown Street
Newton, MA

Project No.: 181.01063 Page: 1

RANSOM
Consulting Engineers and Scientists

BORING LOG: B105

Reviewed by:	JPS	Total Depth:	10 Feet	Logged By:	MJP
Date Reviewed:	4/26/19	Boring Diameter:	6 Inches	Date Drilled:	4/16/19 to 4/16/19
Surface Elevation (ft.):	38 +/-	Well Stickup:	NA	Driller:	NEBC

DEPTH	DESCRIPTION Based on USCS and modified Burmister Soil Classification System	SOIL PROFILE	SAMPLE	SAMPLE NUMBER	BLOWS (per 6")	SPT-N Value	PENETRATION/ RECOVERY		WELL CONSTRUCTION
	S1 (0-2') Loose, brown, fine SAND, some silt, moist.	Topsoil/Loam		S1	3-3-7-13	10	24/16	NA	
	S2 (2-4') Very dense, light brown, fine to medium SAND and pulverized GRAVEL, dry.	Sand and Crushed Gravel		S2	16-24-32-30	56	24/10	NA	
5	S3 (4-6') Very dense, light brown, fine to medium SAND and pulverized GRAVEL, dry.	Sand and Crushed Gravel		S3	23-16-22-21	38	24/12	NA	
	S4 (6-8') Medium dense, brown/gray, medium to coarse SAND, little gravel and silt, moist.	Sand		S4	15-12-15-12	27	24/8	NA	
	S5 (8-10') Medium dense, brown/gray, medium to coarse SAND, little gravel and silt, moist.	Sand		S5	15-9-13-20	22	24/16	NA	
10	End of boring 10'.								
15									
20									

WATER LEVELS:

During Drilling	End of Boring	Date:
NE	NE	4/16/19

WELL LEGEND:

Filter Sand | Native Fill | Bentonite | Bentonite Grout | Concrete | PVC Screen | PVC Riser

NOTES:
1. Soil boring conducted using track-mounted drilling rig with hollow-stem augers.
2. Soil samples collected using 1 3/8" I.D. split-spoon sampler driven by 140 lb. hammer.
3. NA=not applicable; NM=not meaured; NE=not encountered.

CLIENT:
Arrowstreet, Inc.

SITE:
Horace Mann Elementary
687 Watertown Street
Newton, MA

Project No.: 181.01063 Page: 1

APPENDIX B

Laboratory Test Results

Geotechnical Engineering Report
Horace Mann Elementary School
687 Watertown Street
Newton, Massachusetts

ConTest Consultants, Inc.

Providing Inspection/Testing & Consulting Services

LETTER OF TRANSMITTAL

TO: Ransom Consulting - Jay Johonnett

DATE: 4/25/2019

PROJECT: Horace Mann Elementary School 181.01063

CTC PROJECT NO.: 219137

Attached are the following for your use:

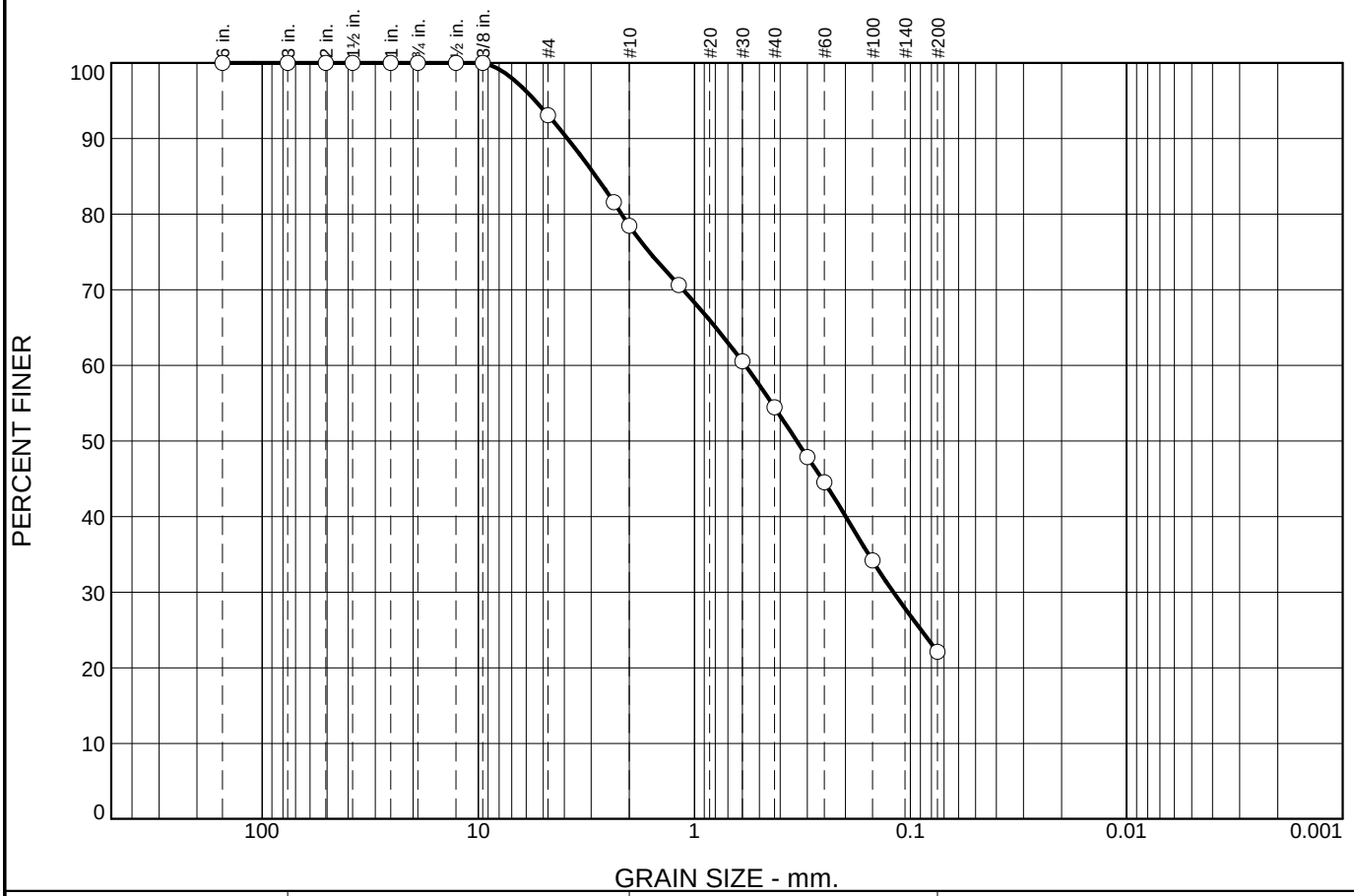
COPIES	DATE	LAB NUMBER	DESCRIPTION
			Concrete Reports - Cylinders
			Concrete Inspection Report
			Reinforcing Steel Inspection Report
			Field Density Report
			Particle Size Distribution Report
2		L-190-19 thru L-192-19	Particle Size Distribution Report
			Atterberg Limits Report

CC: Ransom Consulting - Michael Petro

Reviewed By: Donald Walden

18 Cote Ave. Unit 11 Goffstown, NH 03045
p (603) 626-4422 • *f* (603) 782-0064
www.contestconsultantsinc.com

Particle Size Distribution Report



% +3"	% Gravel			% Sand			% Fines
	Coarse	Medium	Fine	Coarse	Medium	Fine	
0.0	0.0	0.0	21.5	18.0	16.0	22.4	22.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6"	100.0		
3"	100.0		
2"	100.0		
1.5"	100.0		
1"	100.0		
3/4"	100.0		
1/2"	100.0		
3/8"	100.0		
#4	93.1		
#8	81.6		
#10	78.5		
#16	70.6		
#30	60.5		
#40	54.4		
#50	47.9		
#60	44.5		
#100	34.2		
#200	22.1		

* (no specification provided)

Soil Description

coarse to fine SAND, some Silt, some fine Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 3.8669 D_{85}= 2.8537 D_{60}= 0.5817
D_{50}= 0.3362 D_{30}= 0.1199 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

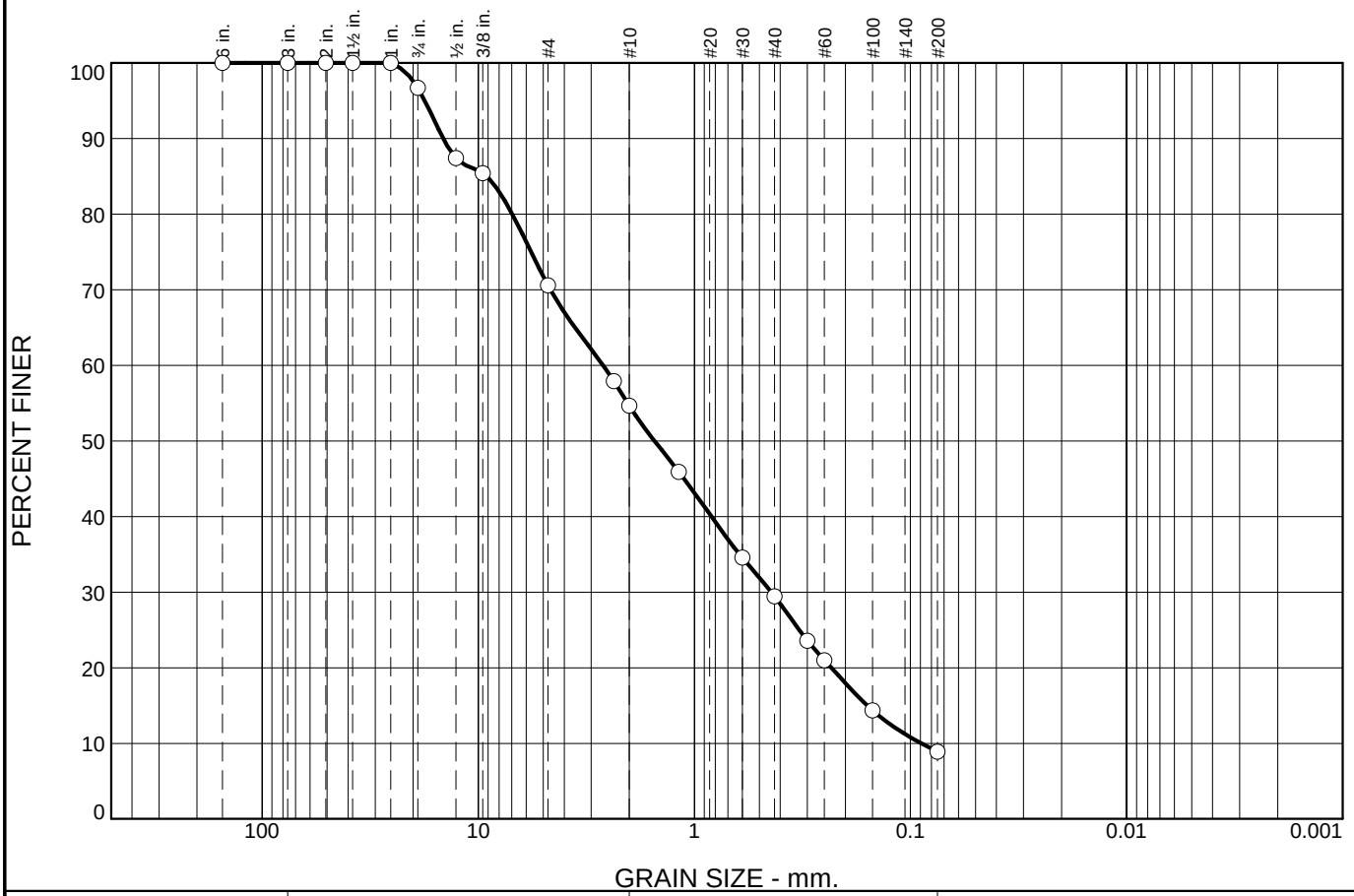
Location: B103 - S3A
Sample Number: L-190-19 **Depth:** 5' - 6' **Date:** 4/25/2019

ConTest Consultants, Inc.

Goffstown, New Hampshire

Client: Ransom Consulting, Inc.
Project: Horace Mann Elementary School 181.01063
Newton, MA
Project No: 219137 **Figure**

Particle Size Distribution Report



% +3"	% Gravel			% Sand			% Fines
	Coarse	Medium	Fine	Coarse	Medium	Fine	
0.0	0.0	14.6	30.8	20.0	13.6	12.1	8.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6"	100.0		
3"	100.0		
2"	100.0		
1.5"	100.0		
1"	100.0		
3/4"	96.7		
1/2"	87.4		
3/8"	85.4		
#4	70.6		
#8	57.9		
#10	54.6		
#16	45.9		
#30	34.6		
#40	29.4		
#50	23.6		
#60	21.0		
#100	14.4		
#200	8.9		

* (no specification provided)

Soil Description

coarse to fine Sand, trace Silt, and med to fine Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 14.5178 D_{85}= 9.1551 D_{60}= 2.6475
D_{50}= 1.5289 D_{30}= 0.4401 D_{15}= 0.1586
D_{10}= 0.0890 C_u= 29.74 C_c= 0.82

Classification

USCS= AASHTO=

Remarks

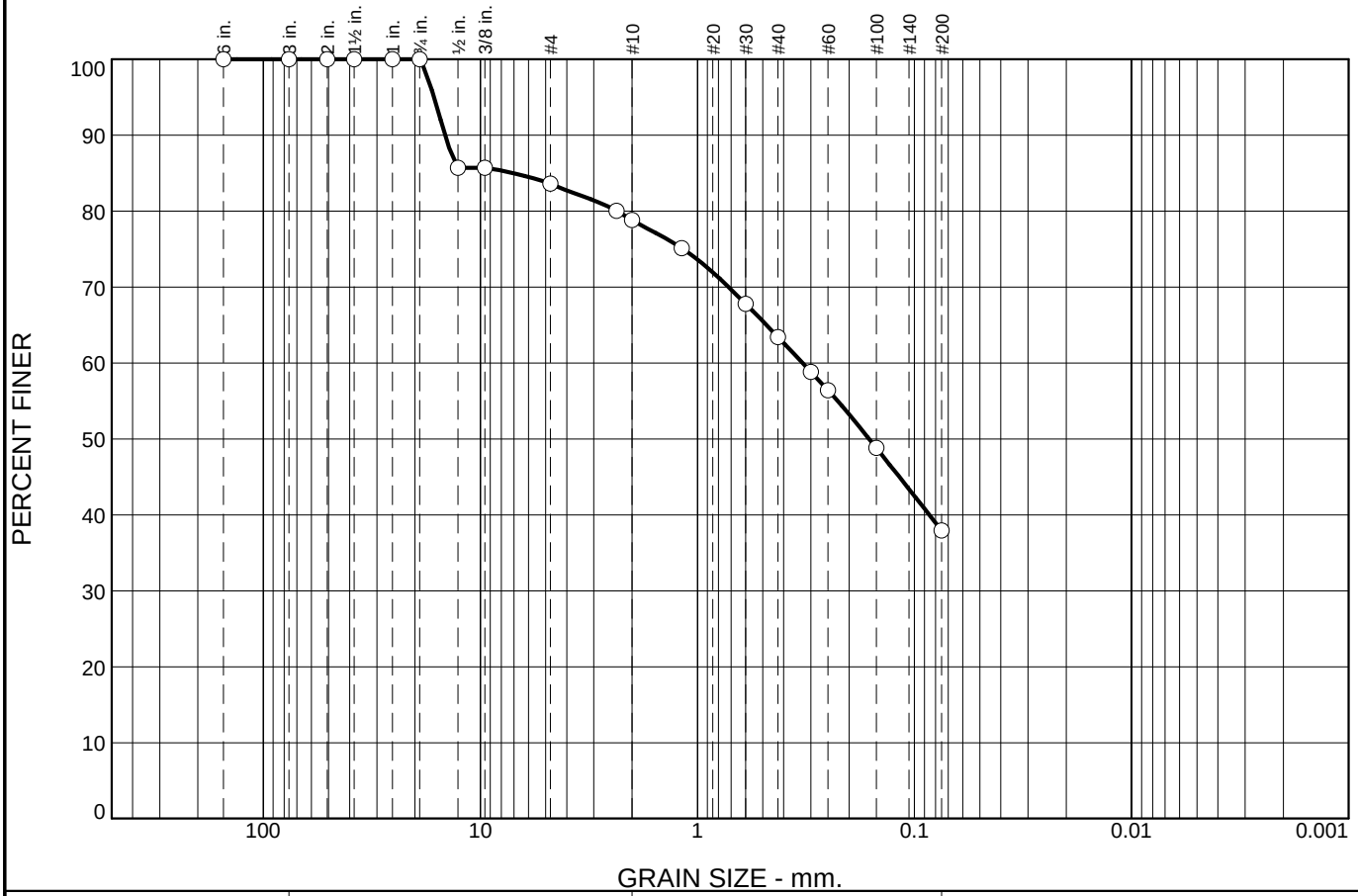
Location: B103 - S4
Sample Number: L-191-19 **Depth:** 10' - 12' **Date:** 4/25/2019

ConTest Consultants, Inc.

Goffstown, New Hampshire

Client: Ransom Consulting, Inc.
Project: Horace Mann Elementary School 181.01063
Newton, MA
Project No: 219137 **Figure**

Particle Size Distribution Report



% +3"	% Gravel			% Sand			% Fines
	Coarse	Medium	Fine	Coarse	Medium	Fine	
0.0	0.0	14.3	6.9	11.0	11.4	18.5	37.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6"	100.0		
3"	100.0		
2"	100.0		
1.5"	100.0		
1"	100.0		
3/4"	100.0		
1/2"	85.7		
3/8"	85.7		
#4	83.6		
#8	80.0		
#10	78.8		
#16	75.1		
#30	67.8		
#40	63.4		
#50	58.8		
#60	56.4		
#100	48.8		
#200	37.9		

* (no specification provided)

Soil Description

coarse to fine Sand, and Silt, some med to fine Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 14.5349 D_{85}= 7.0733 D_{60}= 0.3284
D_{50}= 0.1618 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: B104 - S3
Sample Number: L-192-19 **Depth:** 4' - 6' **Date:** 4/25/2019

ConTest Consultants, Inc.

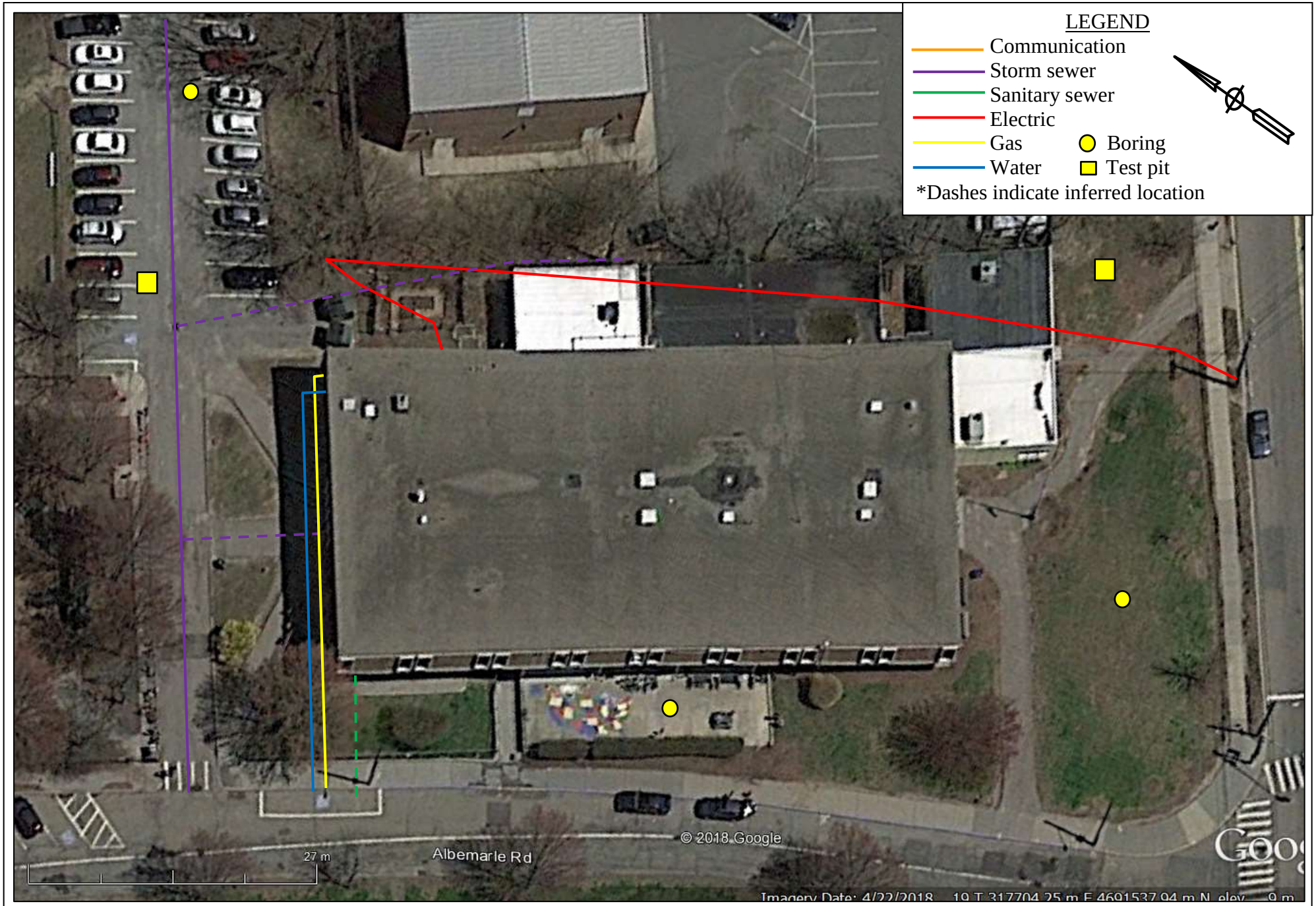
Goffstown, New Hampshire

Client: Ransom Consulting, Inc.
Project: Horace Mann Elementary School 181.01063
Newton, MA
Project No: 219137 **Figure**

APPENDIX C

Locations of Underground Utilities

Geotechnical Engineering Report
Horace Mann Elementary School
687 Watertown Street
Newton, Massachusetts



TPI environmental	687 Watertown St, Newton, MA		Figure 1
	Client: Ransom	Date: 4/9/19	Geophysical Survey Results

NG Environmental Contractors, LLC
Asbestos • Lead Paint Removal • Select Demolition

CLOSEOUT DOCUMENTS

HORACE MANN ELEMENTARY SCHOOL

52 ELLIOT STREET, NEWTON, MA 02461

NG Environmental Contractors, LLC
Asbestos • Lead Paint Removal • Select Demolition

CLOSEOUT DOCUMENTS

HORACE MANN ELEMENTARY SCHOOL

52 ELLIOT STREET, NEWTON, MA 02461

NG Environmental Contractors, LLC
Asbestos • Lead Paint Removal • Select Demolition

CLOSEOUT DOCUMENTS

HORACE MANN ELEMENTARY SCHOOL

52 ELLIOT STREET, NEWTON, MA 02461

A	NOTIFICATIONS
B	WASTE SHIPMENT RECORDS
C	EPA

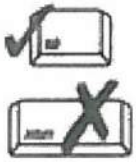
NOTIFICATIONS

Commonwealth of Massachusetts

Asbestos Notification Form ANF-001

100179877
Decal Number

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



INSTRUCTIONS

1. All sections of this form must be completed in order to comply with DEP notification requirements of 310 CMR 7.15 and the Division of Occupational Safety (DOS) notification requirements of 453 CMR 6.12

A. Asbestos Abatement Description

1. a. Is this facility fee exempt - city, town, district, municipal housing authority, owner-occupied residence of four units or less? ☑ Yes ☐ No

   b. Provide blanket decal number if applicable: _____ Blanket Decal Number

2. Facility Location:

   HORACE MANN ELEMENTARY SCHOOL — a. Name of Facility
   687 WATERTOWN STREET — b. Street Address
   NEWTON — c. City/Town
   MA — d. State
   02560 — e. Zip Code
   _____ — f. Telephone Number

3. Worksite Location:

   HORACE MAN ELEMENTAY — a. Building Name/Building Location
   _____ — b. Building #
   _____ — c. Wing
   1,2 — d. Floor
   _____ — e. Room

4. Is the facility occupied? ☐ Yes ☑ No

5. Asbestos Contractor:

   NG ENVIRONMENTAL CONTRACTORS LLC — a. Name
   49 BLANCHARD STREET SUITE 202 — b. Address
   LAWRENCE — c. City/Town
   01843 — d. Zip Code
   9787947922 — e. Telephone Number
   AC000631 — f. DOS License Number
   g. Contract Type: ☐ Written ☐ Verbal
   _____ — h. Facility Contact Person
   _____ — i. Contact Person's Title

6. NOLBERTO GALICIA — a. Name of On-Site Supervisor/Foreman
   AS052665 — b. Supervisor/Foreman DOS Certification Number

7. UNIVERSAL ENVIRONMENTAL SERVICES — a. Name of Project Monitor
   AA000177 — b. Project Monitor DOS Certification Number

8. UNIVERSAL ENVIRONMENTAL SERVICES — a. Name of Asbestos Analytical Lab
   AA000177 — b. Asbestos Analytical Lab DOS Certification Number

9. 7/8/2013 — a. **Project Start Date (mm/dd/yyyy)**
   8/15/2013 — b. **End Date (mm/dd/yyyy)**
   7-4 — c. Work hours Mon-Fri.
   _____ — d. Work hours Sat-Sun.

10. a. What type of project is this?

    ☐ Demolition ☑ Renovation
    ☐ Repair ☐ Other, please specify: _____ b. Describe

11. a. Check abatement procedures:

    ☐ Glove bag ☐ Encapsulation
    ☐ Enclosure ☐ Disposal only
    ☐ Cleanup ☑ Other, specify: POLY AROUND THE STRUCTURE — b. Describe
    ☑ Full containment

12. Is the job being conducted: ☑ Indoors? ☑ Outdoors?

ANF001102001

Commonwealth of Massachusetts

Asbestos Notification Form ANF-001

100179877
Decal Number

A. Asbestos Abatement Description (cont.)

13. Total amount of each type of Asbestos Containing Materials (ACM) to be removed, enclosed, or encapsulated:

	Lin. ft.	Sq. ft.
a. Total pipes or ducts (linear ft)	1800	
b. Total other surfaces (square ft)		0
c. Boiler, breaching, duct, tank surface coatings		
d. Insulating cement		
e. Corrugated or layered paper pipe insulation		
f. Trowel/Sprayer coatings		
g. Spray-on fireproofing		
h. Transite board, wall board		
i. Cloths, woven fabrics		
j. Other, please specify:	1800	
k. Thermal, solid core pipe insulation		
l. Specify: PCBSCAULKING		

14. Describe the decontamination system(s) to be used:

3 CHAMBERS DECONTAMINATION SYSTEM

15. Describe the containerization/disposal methods to comply with 310 CMR 7.15 and 453 CMR 6.14(2) (g):

DOUBLE BAG SEALED AND LABELED

16. For Emergency Asbestos Operations, the DEP and DOS officials who evaluated the emergency:

a. Name of DEP Official: N/A	b. Title
c. Date (mm/dd/yyyy) of Authorization	d. DEP Waiver #
e. Name of DOS Official	f. DOS Official Title
g. Date (mm/dd/yyyy) of Authorization	h. DOS Waiver #

17. Do prevailing wage rates as per M.G.L. c. 149, § 26, 27 or 27A–F apply to this project? ☑ Yes ☐ No

B. Facility Description

1. Current or prior use of facility: ELEMENTARY SCHOOL

2. Is the facility owner-occupied residential with 4 units or less? ☑ Yes ☐ No

3. a. Facility Owner Name: CITY OF NEWTON
   b. Address: 1000 COMMONWEALTH AVE
   c. City/Town: NEWTON
   d. Zip Code: 02459
   e. Telephone Number (area code and extension): 617-7961000

4. a. Name of Facility Owner's On-Site Manager: N/A
   b. On-Site Manager Address:
   c. City/Town:
   d. Zip Code:
   e. Telephone Number (area code and extension):

ANF001100202

Commonwealth of Massachusetts

Asbestos Notification Form ANF-001

100179877
Decal Number

B. Facility Description (cont.)

5. LAMBRIAN CONSTRUCTION CORP
a. Name of General Contractor

384 WASHINGTON STREET
b. Address

WESTWOOD MA
c. City/Town

02090
d. Zip Code

e. Telephone Number (area code and extension)

f. Contractor's Worker's Comp. Insurer

g. Policy Number

h. Exp. Date (mm/dd/yyyy)

6. What is the size of this facility?

10000
a. Square Feet

2
b. Number of floors

C. Asbestos Transportation and Disposal

1. Transporter of asbestos-containing material from site to temporary storage site (if necessary):

NG ENVIRONMENTAL CONTRACTORS, LLC
a. Name of Transporter

49 BLANCHARD STREET
b. Address

LAWRENCE MA
c. City/Town

01843
d. Zip Code

9787947922
e. Telephone Number

Note: Transfer Stations must comply with the Solid Waste Division Regulations 310 CMR 19.000

2. Transporter of asbestos-containing waste material from removal/temporary site to final disposal site:

SERVICES TRANSPORT GROUP
a. Name of Transporter

58 PYLES LN
b. Address

NEW CASTLE DE
c. City/Town

19720
d. Zip Code

8777999955
e. Telephone Number

3. N/A
a. Refuse Transfer Station and Owner

b. Address

c. City/Town

d. Zip Code

e. Telephone Number

4. MINERVA ENTERPRISES INC
a. Final Disposal Site Location Name

b. Final Disposal Site Location Owner's Name

9000 MINERVA ROAD
c. Final Disposal Site Address

WAYNESBURG
d. City/Town

OH
e. State

44688
f. Zip Code

g. Telephone Number

D. Certification

The undersigned hereby states, under the penalties of perjury, that he/she has read the Commonwealth of Massachusetts regulations for the Removal, Containment or Encapsulation of Asbestos, 453 CMR 6.00 and 310 CMR 7.15, and that the information contained in this notification is true and correct to the best of his/her knowledge and belief.

NOLBERTO GALICIA
a. Name

NOLBERTO GALICIA
b. Authorized Signature

PRESIDENT
c. Position/Title

6/19/2013
d. Date (mm/dd/yyyy)

9787947922
e. Telephone Number

NG ENVIRONMENTAL C
f. Representing

49 BLANCHARD STREET
g. Address

LAWRENCE MA
h. City/Town

01843
i. Zip Code

ANF001002003

BWP AQ 06

Notification Prior to Construction or Demolition

100179880
Decal Number

General Statement: If asbestos is found during a Construction or Demolition operation, all responsible parties must comply with 310 CMR 7.00, 7.09, 7.15, and Chapter 21E of the General Laws of the Commonwealth. This would include, but would not be limited to, filing an asbestos removal notification with the Department and/or a notice of release/threat of release of a hazardous substance to the Department, if applicable.

B. General Project Description (cont.)

4. General Contractor:

LAMBRIAN CONSTRUCTION
a. Name

384 WASHINGTON STREET
b. Address

WESTWOOD	MA	02090
c. City/Town	d. State	e. Zip Code

7814611100	
f. Telephone Number (area code and extension)	g. E-mail Address (optional)

JAMES LAMBRIANIDIS
h. On-site Manager Name

C. General Construction or Demolition Description

1. Construction or demolition contractor:

NG ENVIRONMENTAL CONTRACTORS, LLC
a. Name

49 BLANCHARD STREET
b. Address

LAWRENCE	MA	01843
c. City/Town	d. State	e. Zip Code

9787947922	
f. Telephone Number (area code and extension)	g. E-mail Address (optional)

ROBERT VEILLEUX
h. On-site Manager Name

2. On-Site Supervisor:

MIGUEL T BAEZ
On-Site Supervisor Name

3. Is the entire facility to be demolished? ☐ Yes ☑ No

4. Describe the area(s) to be demolished:

WINDOWS AND DOORS

5. If this is a construction project, describe the building(s) or addition(s) to be constructed:

REPLACEMENT OF WINDOWS AND DOORS

AQ0610020002

BWP AQ 06

Notification Prior to Construction or Demolition

100179880
Decal Number

C. General Construction or Demolition Description (cont.)

6. a. If this is a demolition project, were the structure(s) surveyed for the presence of asbestos containing material (ACM)?

☑ Yes ☐ No

If yes, who conducted the survey?

UNIVERSAL ENVIRONMENTAL CONSULTANTS
b. Survevor Name

AA000177
c. Division of Occupational Safety Certification Number

7. Construction or Demolition:

7/8/2013
a. **Start Date (mm/dd/yyyy)**

8/15/2013
b. **End Date (mm/dd/yyyy)**

8. a. For demolition and construction projects, indicate dust suppression techniques to be used:

☐ seeding
☑ wetting
☐ covering
☐ paving
☐ shrouding
☐ other

b. If other, please specify:

9. For Emergency Demolition Operations, who is the DEP official who evaluated the emergency?

N/A
a. Name of DEP Official

b. Title

c. Date (mm/dd/yyyy) of Authorization

d. DEP Waiver Number

D. Certification

I certify that I have examined the above and that to the best of my knowledge it is true and complete. The signature below subjects the signer to the general statutes regarding a false and misleading statement(s).

NOLBERTO GALICIA
a. Print Name

NOLBERTO GALICIA
b. Authorized Signature

PRESIDENT
c. Position/Title

NG ENVIRONMENTAL CONTRACTORS, LLC
d. Representing

6/19/2013
e. Date (mm/dd/yyyy)

AQ0610020003

B

WASTE SHIPMENT RECORDS

SERVICE TRANSPORT GROUP, INC.

58 PYLES LANE, NEW CASTLE, DE 19720 PHONE: (877) 999-9559

№ 411101

WASTE SHIPMENT RECORD

S.T.G. # _____

GENERATOR

1. Material Origin Site	Generator: Name/Address	Generator: Phone #
HORACE MANN ELEMENTARY SCHOOL 687 WATERTOWN STREET NEWTON, MA 02560	CITY OF NEWTON 1000 COMMONWEALTH AVENUE NEWTON, MA 02459	

2. Removal Contractor: Name/Address	Contractor: Phone #
NG ENVIRONMENTAL CONTRACTORS, LLC 49 BLANCHARD ST LAWRENCE, MA 01843 Contact: NOLBERTO GALICIA	978-794-7922

3. Responsible Agency: Name/Address	4. US DOT Class - FRIABLE ASBESTOS ONLY
US EPA REGION I 5 POST OFFICE SQUARE, STE 100 BOSTON, MA 02119	NA2212, Asbestos, 9, PG III, RQ

5. Description of Materials Specify Friable or Non-Friable	Containers No. Type	Total Quantity
IF Friable (enter required information)	PCB BULK PRODUCT WASTE	15 CUBIC YARDS
IF Non-Friable (check one): ☐ Category I ☐ Category II	AS PER PROFILE	

6. Special Handling Instructions

7. Generator Certification:
This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport by highway according to the applicable regulations of the Department of Transportation, US E.P.A., and any other state government agency. I certify that the foregoing is true and correct to the best of my knowledge. If the waste shipment is not as I stated, I accept the RETURN of the COMPLETE LOAD to the generator's service location at the generator's expense.

Printed/Typed Name & Title	Signature	Date
Miguel T Baez / Supervisor	Miguel T Baez	08/21/2013

TRANSPORTER

8. Transporter 1 (Acknowledgement of Receipt of Materials) If blank, see Transporter 2 or 3 below.

Company Name & Address	Signature / Printed Name / Title	Telephone No. / Date
NG ENVIRONMENTAL CONTRACTORS, LLC 49 BLANCHARD ST LAWRENCE, MA 01843	Signature: _____ Printed Name: _____ Title: _____	Telephone No. Date:

9. Transporter 2 (Acknowledgement of Receipt of Materials) If Transporter 1 & 2 are blank, Transporter 3 servers as sole transporter.

Company Name & Address	Signature / Printed Name / Title	Telephone No. / Date
# 10	Signature: _____ Printed Name: C Done Title: _____	Telephone No. Date: 8-23-13

10. Transporter 3 (Acknowledgement of Receipt of Materials)

Company Name & Address	Signature / Printed Name / Title	Telephone No. / Date
Service Transport Group, Inc. 58 Pyles Lane New Castle, DE 19720	Signature: _____ Printed Name: _____ Title: _____	Telephone No. 877-999-9559 Date:

DISPOSAL SITE

11. Discrepancy Indication Space:

12. Waste Disposal Site Owner or Operator's Certification (Receipt of above Waste except as noted in 11)

Waste Disposal Site (Check One)		STG USE ONLY		
Sanitary Landfill ☐ 901 Tyrol Blvd. Belle Vernon, PA 15012 724-929-7694 Ext. 14 Permit No. 100277	Minerva Landfill ☐ 8955 Minerva Rd. Waynesburg, OH 44688 330-866-3435 Permit No. P0104984	☐	Signature: _____ Printed Name: _____ Title: _____	Date:

WHITE-Generator • GREEN-S.T.G. • YELLOW-Contractor • PINK-Landfill • GOLD-Pick Up Receipt

SERVICE TRANSPORT GROUP, INC.

58 PYLES LANE, NEW CASTLE, DE 19720 PHONE: (877) 999-9559

Nº 411101

WASTE SHIPMENT RECORD

S.T.G. # _____

GENERATOR

1. Material Origin Site	Generator: Name/Address	Generator: Phone #
HORACE MANN ELEMENTARY SCHOOL 687 WATERTOWN STREET NEWTON, MA 02560	CITY OF NEWTON 1000 COMMONWEALTH AVENUE NEWTON, MA 02459	

2. Removal Contractor: Name/Address	Contractor: Phone #
NG ENVIRONMENTAL CONTRACTORS, LLC 49 BLANCHARD ST LAWRENCE, MA 01843 Contact: NOLBERTO GALICIA	978-794-7922

3. Responsible Agency: Name/Address	4. US DOT Class - FRIABLE ASBESTOS ONLY
US EPA REGION I 5 POST OFFICE SQUARE, STE 100 BOSTON, MA 02119	NA2212, Asbestos, 9, PG III, RQ

5. Description of Materials Specify Friable or Non-Friable	Containers No. Type	Total Quantity
IF Friable (enter required information)	PCB BULK PRODUCT WASTE	15 CUBC YARDS
IF Non-Friable (check one): ☐ Category I ☐ Category II	AS PER PROFILE	

6. Special Handling Instructions

7. Generator Certification:

This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport by highway according to the applicable regulations of the Department of Transportation, US E.P.A., and any other state government agency. I certify that the foregoing is true and correct to the best of my knowledge. If the waste shipment is not as I stated, I accept the RETURN of the COMPLETE LOAD to the generator's service location at the generator's expense.

Printed/Typed Name & Title	Signature	Date
Miguel T Baez/Supervisor	Miguel T Baez	08/21/2013

TRANSPORTER

8. Transporter 1 (Acknowledgement of Receipt of Materials) If blank, see Transporter 2 or 3 below.

Company Name & Address	Signature / Printed Name / Title	Telephone No. / Date
NG ENVIRONMENTAL CONTRACTORS, LLC 49 BLANCHARD ST LAWRENCE, MA 01843	Signature: _____ Printed Name: _____ Title: _____	Telephone No. Date:

9. Transporter 2 (Acknowledgement of Receipt of Materials) If Transporter 1 & 2 are blank, Transporter 3 servers as sole transporter.

Company Name & Address	Signature / Printed Name / Title	Telephone No. / Date
	Signature: _____ Printed Name: _____ Title: _____	Telephone No. Date:

10. Transporter 3 (Acknowledgement of Receipt of Materials)

Company Name & Address	Signature / Printed Name / Title	Telephone No. / Date
Service Transport Group, Inc. 58 Pyles Lane New Castle, DE 19720	Signature: _____ Printed Name: _____ Title: _____	Telephone No. 877-999-9559 Date:

DISPOSAL SITE

11. Discrepancy Indication Space:

12. Waste Disposal Site Owner or Operator's Certification (Receipt of above Waste except as noted in 11)

Waste Disposal Site (Check One)		STG USE ONLY		
Sanitary Landfill ☐ 901 Tyrol Blvd. Belle Vernon, PA 15012 724-929-7694 Ext. 14 Permit No. 100277	Minerva Landfill ☐ 8955 Minerva Rd. Waynesburg, OH 44688 330-866-3435 Permit No. P0104984	☐	Signature: _____ Printed Name: _____ Title: _____	Date:

WHITE-Generator • GREEN-S.T.G. • YELLOW-Contractor • PINK-Landfill • GOLD-Pick Up Receipt

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number: 40C FRP ART /61
2. Page 1 of: 1
3. Emergency Response Phone: (800) 535-5053
4. Manifest Tracking Number: 012083710 JJK

5. Generator's Name and Mailing Address: CITY OF NEWTON PUBLIC BLDGS
HORACE MANN ELEMENTARY SCHOOL
52 ELLIOT STREET
NEWTON, MA 02461
Generator's Phone: (617) 796-1618

Generator's Site Address (if different than mailing address):
HORACE MANN ELEMENTARY SCHOOL
687 WATERTOWN STREET
NEWTON, MA 02461

6. Transporter 1 Company Name: EQ NORTHEAST, INC — U.S. EPA ID Number: MAD 084 814 136

7. Transporter 2 Company Name: — U.S. EPA ID Number:

8. Designated Facility Name and Site Address: WAYNE DISPOSAL, INC SITE #2 LANDFILL
49350 N I-94 SERVICE DRIVE
BELLEVILLE, MI 48111
Facility's Phone: (800) 592-5489
U.S. EPA ID Number: MID 048 090 633

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
X	1. RQ, UN3432, Polychlorinated biphenyls, solid, 9, PGIII, ERG #171	001	CF	25	K	PCB6 MA02
	2.					
	3.					
	4.					

14. Special Handling Instructions and Additional Information
1. G131 (99WDI / (S) PCB CONTAMINATED SOLIDS / SEE ATTACHED PCB CONTINUATION SHEET

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: Paul T. Ferr[illegible] — Signature: [signature] — Month / Day / Year: [illegible] / [illegible] / 13

16. International Shipments: ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

17. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: [illegible handwriting] — Signature: [signature] — Month / Day / Year: 8 / 22 / 13
Transporter 2 Printed/Typed Name: — Signature: — Month / Day / Year:

18. Discrepancy
18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
Manifest Reference Number:
18b. Alternate Facility (or Generator) — U.S. EPA ID Number:
Facility's Phone:
18c. Signature of Alternate Facility (or Generator) — Month / Day / Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)
1. PCB 2. 3. 4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a
Printed/Typed Name: — Signature: — Month / Day / Year

GENERATOR / INT'L / TRANSPORTER / DESIGNATED FACILITY

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

GENERATOR'S INITIAL COPY

PCB CONTINUATION SHEET

49350 N. I-94 Service Drive, Belleville, MI 48111 Phone: (800) 592-5489 Fax: (734) 699-1532

Generator Name HORACE MANN ELEMENTARY SCHOOL Manifest Doc. No. 01208371 [illegible]

Generator Address [illegible] WATERTOWN STREET NEWTON MA 02461

Generator USEPA ID No. 40CFRPART761 State Manifest No. ______

1. LINE ITEM #	2. UNIQUE DRUM NO. OR SERIAL/ID NO.	3. PCB WASTE IDENTITY/ DESCRIPTION	4. STORAGE START DATE	5. WT. IN Kg OF THE PCB WASTE
1	/	PCB CONTAMINATED SOLIDS	[illegible]	[illegible]
1		PCB CONTAMINATED SOLIDS		
1		PCB CONTAMINATED SOLIDS		
1		PCB CONTAMINATED SOLIDS		
1		PCB CONTAMINATED SOLIDS		

I hereby certify that all information submitted on this and all associated documents is complete and accurate to the best of my knowledge and information.

Generator Signature [illegible] Title [illegible]

Printed Name [illegible] Date [illegible]

 FORM 1032 Rev. 4/97

GENERATOR 1ST COPY

THE ENVIRONMENTAL QUALITY COMPANY

EQ Northeast, Inc.
185 Industrial Road
Wrentham, MA 02093

Emergency Response #:
Phone: (508) 384-6151
Fax: (508) 384-6029

Work Order: 4701700
Arrival Time:
Date: 08/01/2013
Prepared By: Sharon Amaral

BILLING INFORMATION

Name: NG ENVIRONMENTAL CONTRACTO Contact:
Acct #: 15193-26 Title:
Phone: (978) 794-7922 Phone:
Addr: 49 BLANCHARD STREETSUITE #208 LAWRENCE, MA 01843 Mobile:
PO / Rel:

GENERATOR INFORMATION

Name: HORACE MANN ELEMENTARY Contact:
EPA #: 40CFRPART761 ID: 115003 Title:
Phone: (617) 796-1815 Phone:
Addr: 687 WATERTOWN STREET NEWTON, MA 02461 Mobile:

TSDF INFORMATION

TSDF: WAYNE DISPOSAL INC. SITE #2 LAND
Addr: 49350 N I-94 SERVICE DRIVE
BELLEVILLE MI 48111

EPA #: MID048090633
Phone: (800) 592-5489
Fax:

Manifest: 012083710JJK

TSDF: WAYNE DISPOSAL INC. SITE #2 LANDFI EPA #: MID048090633
Addr: 49350 N I-94 SERVICE DRIVE Phone: (800) 592-5489
BELLEVILLE MI 48111 Fax:

HM DESCRIPTION	# OF CONT.	TYPE	QUANTITY	UNIT
UN3432 (RQ, Polychlorinated biphenyls, solid), 9, PGII Approval Code: G131199WDI 446670 Waste Codes: PCB1, MA01 Hand. Instruct: SEE ATTACHED PCB CONTINUATION SHEET	001	CF	25	Y

EQUIPMENT ACKNOWLEDGMENT

Customer acknowledges that this equipment is suitable for the transportation, storage or other service to be provided.

Tractor #____ Trailer # 423 Tanker #____ Roll-Off Box #____ w/ liner?____ Spotted #____ Picked up #____ Vac Fee ____

Driver Signature | Date | Customer Signature | Date

Pickup	Date	Time	Explanation
Arrive at Shipper		930	[illegible] 1 container
Start Loading	8/22		
Finish Loading			
Leave Site		10 21	

[illegible fine print]

[signature] 8/22/13 [signature] 8/22/13

Driver Signature | Date | Customer Signature | Date

Delivery	Date	Time	Explanation
Arrive at TSDF			
Start Unloading			
Finish Unloading			
Leave Site			

Driver Signature | Date | Receiver Signature | Date

Please comment on the ways we can continue to provide better service. Excellent Satisfactory Poor

THE ENVIRONMENTAL QUALITY COMPANY

EQ Northeast, Inc.
185 Industrial Road
Wrentham, MA 02093

Emergency Response #:
Phone: (508) 384-6151
Fax: (508) 384-6028

Work Order: 4701701
Arrival Time:
Date: 08/20/2013
Prepared By: Sharon Amaral

BILLING INFORMATION

Name: NS ENVIRONMENTAL CONTRACTC Contact:
Acct. #: 15193-26 Title:
Phone: (978) 794-7822 Phone:
Addr: 49 BLANCHARD STREET SUITE #209 LAWRENCE, MA 01843 Mobile:
PO / Rel:

GENERATOR INFORMATION

Name: HORACE MANN ELEMENTARY Contact:
EPA #: 40CFRPART761 ID: 116003 Title:
Phone: (617) 796-1515 Phone:
Addr: 687 WATERTOWN STREET NEWTON, MA 02461 Mobile:

TSDF INFORMATION

TSDF: UNDEFINED
Addr:

EPA #: UNDEFINED
Phone:
Fax:

On-Site Directions: ***PLEASE BRING 5 MAVERICKS AND LINERS WITH 5 PALLETS TO SITE TO LOAD BAGS***

Manifest: ____________

TSDF: UNDEFINED
Addr:

EPA #: UNDEFINED
Phone:
Fax:

HM DESCRIPTION — # OF CONT. TYPE QUANTITY UNIT

1. Deliver QTY ____ empty Maverick, One Cubic Yard Box, DOT approved
Approval Code: MAVERICK YARD BOX (1127) Waste Codes: NONE
Hand. Instruct:

2. Deliver QTY ____ Maverick Poly Liner
Approval Code: MAVERICK POLY LINER (150) Waste Codes: NONE
Hand. Instruct:

3. Deliver QTY ____ Pallet, wood
Approval Code: PALLET, WOOD (15030) Waste Codes: NONE
Hand. Instruct:

EQUIPMENT ACKNOWLEDGMENT

Customer acknowledges that this equipment is suitable for the transportation, storage or other service to be provided.

Tractor # ____ Trailer # ____ Tanker # ____ Roll-Off Box # ____ w/ liner? ____ Spotted # ____ Picked up # ____ Var Fee ____

Driver Signature | Date | Customer Signature | Date

Pickup	Date	Time	Explanation
Arrive at Shipper			
Start Loading			
Finish Loading			
Leave Site			

Driver Signature | Date | Customer Signature | Date

Delivery	Date	Time	Explanation
Arrive at TSDF	8/22	9:32	Delivered / maverick liners and pallets
Start Unloading			
Finish Unloading			
Leave Site		10:21	

[signature] 8/22/13 [signature] 8/22/13
Driver Signature | Date | Receiver Signature | Date

Please comment on the job so we can continue to provide better service: Excellent Satisfactory Poor

C

EPA

Robert

From: Woodward, Katherine [Woodward.Katherine@epa.gov]
Sent: Monday, July 22, 2013 10:19 AM
To: adieb@uec-env.com; Robert
Cc: Tisa, Kimberly
Subject: Contractor Work plan-Horace Mann

EPA has reviewed the revised contractor work plan. With the exception of disposal of liquid PCB waste, EPA has no further comments. The work may proceed in accordance with the Notification, the Approval and the Contractor Work Plan. EPA expects that once the contingency plan for disposal of PCB liquid waste with a concentration > .5 ppb has been formulated, the contractor will submit this plan to EPA for review.

Please feel free to contact me if there are any questions

Kate

Katherine A Woodward, PE
US Environmental Protection Agency
5 Post Office Square, Suite 100
Mail Code: OSRR07-2
Boston, MA 02109-3912
Phone: (617)918-1353
Fax: (617)918-0353

Robert 1 of 2

From: Woodward, Katherine [Woodward.Katherine@epa.gov]
Sent: Wednesday, August 07, 2013 9:46 AM
To: Robert
Subject: RE: Contractor Work plan-Horace Mann

Robert,

As long as you liquid wastes remain below 0.5 ppb you can dispose of it as waste water. EQ should remain as a contingency in case something changes. As long as this remains the case, EPA has no further comments and the work may proceed in accordance with the Notification, Approval and the Contractor Work Plan

Kate

From: Robert [mailto:rveilleux@ngenvironmental.com]
Sent: Tuesday, August 06, 2013 5:13 PM
To: Woodward, Katherine
Subject: RE: Contractor Work plan-Horace Mann

Hello Kate,

I finally received the results from Con-Test Laboratories of the water samples we took at the Horace Mann Elementary School project. I attached the results to this email, because as far as I can see, there are no detectable amounts of PCBs. I'm assuming that because the levels of PCB's are not detectable that we can legally dispose of the water as regular waste water since it's under .5ppb. I wanted to double check with you or Kim if this is true. If, this is true then I will not need the services of EQ Northeast and we should be able to get a final written approval of our work plan. Please contact me as soon as you have a moment. Thank you for your time and I look forward to hearing from you.

Robert L. Veilleux Jr.
Project Manager/Estimator
NG Environmental Contractors LLC
49 Blanchard Street
Lawrence, MA 01843
Office: 978-794-7922
Fax: 978-794-7923
Cell: 978-476-6905
http://www.ngenvironmental.com

From: Woodward, Katherine [mailto:Woodward.Katherine@epa.gov]
Sent: Monday, July 22, 2013 10:19 AM
To: adieb@uec-env.com; Robert
Cc: Tisa, Kimberly
Subject: Contractor Work plan-Horace Mann

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Please feel free to contact me if there are any questions

Kate

Katherine A Woodward, PE
US Environmental Protection Agency
5 Post Office Square, Suite 100
Mail Code: OSRR07-2
Boston, MA 02109-3912
Phone: (617)918-1353
Fax: (617)918-0353

EMSL Analytical, Inc.
5 Constitution Way, Unit A, Woburn, MA 01801
Phone/Fax: (781) 933-8411 / (781) 933-8412
http://www.EMSL.com bostonlab@emsl.com

EMSL Order:	132002715
CustomerID:	UEC63
CustomerPO:	
ProjectID:	

Attn: **Ammar Dieb**
Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702

Phone:	(508) 628-5486
Fax:	(508) 628-5488
Received:	04/10/20 1:00 PM
Collected:	4/10/2020

Project: **687 Watertown Street; Newton, MA**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
1	*132002715-0001*	4/10/2020	4/13/2020	0.1338 g	27 % wt
	Site: Room 131 Desc: Paint/Primer on Structural Steel				
2	*132002715-0002*	4/10/2020	4/13/2020	0.2488 g	7.5 % wt
	Site: Room 201 Desc: Paint/Primer on Structural Steel				

Eric Steele, Laboratory Manager
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. When the information supplied by the customer can affect the validity of the results, it will be noted on the reoprt. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Woburn, MA AIHA-LAP, LLC - ELLAP Accredited #180179

Initial report from 04/13/2020 10:00:50

OrderID: 132002715

132002715

CHAIN OF CUSTODY

Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702
Tel: (508) 628-5486 - Fax: (508) 628-5488
adieb@uec-env.com

Lead
24-hour TAT

Town/City: Newton, MA Building Name 687 Watertown Street

Sample	Result	Description of Material	Sample Location
1		Paint/Primer on structural steel	Room 131
2		1 1	Room 201

Reported By: Jason Beutte Date: 4-10-20 Due Date: ----------

Received By: ---------- Date: ----------

REC'D Spl 1300
EMSL-BOSTON APR 10 2020

UNIVERSAL ENVIRONMENTAL CONSULTANTS

FLI Environmental

69 Bridge Street
Dedham, MA 02026
Phone 781.251.0040
Fax 781.251.0901

February 10, 2019

Arthur Cabral
City of Newton
52 Elliot Street
Newton, MA 02461-1605

Re: Horace Mann Elementary School, Newtonville, MA
AHERA 3-year Re-inspection
FLI Project # 18-2628

Dear Mr. Cabral:

FLI Environmental, Inc. is pleased to submit the enclosed Asbestos Hazard Emergency Response Act (AHERA) 3-year Re-inspection report for the following school:

Horace Mann Elementary School
687 Watertown Street
Newtonville, Massachusetts

Re-inspection reports are part of the school's AHERA Management Plan and should be maintained on file at the School Department's administrative offices and at the school. The recommended response actions included in the report should be reviewed by the school's AHERA designated person and implemented as soon as feasible.

The following information is included in this report:

Table 1. Facility and Accreditation Information
Table 2. Recordkeeping Review
Table 3. Re-inspection Results and Recommended Response Actions
Table 4. Summary of Abatement Activity
Table 5. Evaluation of Resources
Appendix A. AHERA Schedule of Activities, 2019-2022
Appendix B. Supplemental AHERA Information
Appendix C. 6-Month Survey Form

We have also enclosed a copy of the Designated Person's Self-Study Guide. This guide was developed by the U.S. Environmental Protection Agency (EPA) to help staff appointed to the role of designated person to understand their responsibilities under the EPA AHERA regulations.

FLI's EPA-AHERA Accredited and Massachusetts Licensed Asbestos Management Planner reviewed the Operations & Maintenance Program on file for the Franklin School. The review was done in accordance with *A Guide to Performing Reinspections Under the Asbestos Hazard Emergency Response Act (AHERA)* (March, 1992). The Management Planner found the O&M Plan to be adequate for managing the remaining Asbestos Containing Materials present in the building.

It should be noted that during the re-inspection multiple recordkeeping deficiencies were noted. It is recommended that a thorough review of all program information be completed and copies of all applicable documentation is kept on file at the school.

If you have any questions regarding this report, please contact Jody Freitas at 781-251-0040.

Sincerely,

FLI ENVIRONMENTAL, INC.

BY:

Jody Freitas
Senior Project Manager
jfreitas@flienv.com
781-251-0040

Enclosure

CONTENTS

TABLES

Appendices

Table 1. Facility and Accreditation Information
Horace Mann Elementary School, Newtonville, MA
February 10, 2019

School:	Horace Mann Elementary School 687 Watertown Street Newtonville, Massachusetts
Principal:	Mr. Mark Nardelli
LEA Designated Person:	Mr. Arthur F. Cabral (617) 796-1600 Public Buildings Director of Facilities City of Newton 52 Elliot Street Newton, MA 02461

The undersigned certifies that the LEA responsibilities outlined in EPA-AHERA 40 CFR 763.84 will be met

Designated Person Signature:	 Arthur F. Cabral
Re-inspection Date:	January 10, 2019
Inspector Signature:	
Accredited Inspector:	Jody Freitas
Massachusetts DOS[1] Certification:	AI-900238
Certification Expiration:	February 12, 2019
Management Planner Signature:	
Accredited Management Planner:	Jody Freitas
Massachusetts DOS[1] Certification:	AP-000051
Certification Expiration:	February 12, 2019
Company:	FLI Environmental, Inc. 69 Bridge Street Dedham, MA 02026 (781) 251-0040

Table 2. Recordkeeping Review Horace Elementary School Newtonville, MA February 10, 2019	
1. The LEA is required to perform periodic surveillance of all ACBM located within the school building(s) at least once every six months. Any changes in the condition of the ACBM must be noted. A written, dated record of the surveillance results must be maintained in the school's AHERA records.	
Periodic inspection records present?	**1**
Comment: LEA plans to hire an outside consultant who will be performing the inspections going forward	
2. The LEA is required to provide all currently employed custodial and maintenance staff with appropriate asbestos-related training. Evidence of completion of training must be maintained with the school's AHERA records.	
Training records present?	**Yes**
Comment: Training records for the custodial staff are available in the administrative office	
3. A copy of the school's Asbestos Management Plan must be maintained at each school and be available for inspection by interested parties.	
Management Plan present?	**Yes**
Comment: None	
4. Annual written notification of the availability of the Asbestos Management Plan must be provided to parent, teacher, and employee organizations. A written, dated record of each yearly communication must be maintained with the school's AHERA records.	
Annual communication records present?	**1 New**
Comment: The LEA will send written notification as required above going forward.	
5. The LEA must maintain with the school's AHERA records detailed written records of all removal, operations-and-maintenance, response-action and cleaning activities performed on any ACBM located within the school building(s).	
Abatement records present?	**Yes**
Comment: A summary of abatement activities is kept in the LEA administrative office**.**	

Table 3 - Re-inspection Results and Recommended Response Actions

No.	ACBM/Assumed ACBM Description	Functional Space Location	Friability	Assess. Category	Quantity	Comments	Recommended Response Action	Recommended Completion Date
1	Boiler Insulation	Boiler Room	F	5	260 SF	Good Condition	The LEA shall attach labels indicating asbestos containing materials (ACM) on the material where they will clearly be noticed by employees who are likely to be exposed working in those areas.	June 10, 2019
2	Breeching Insulation	Boiler Room	F	5	NA	Abated 7/2/2016	NA	NA
3	Generator Insulation	Boiler Room	F	5	15 LF	Good Condition	The LEA shall attach labels indicating asbestos containing materials (ACM) on the material where they will clearly be noticed by employees who are likely to be exposed working in those areas.	June 10, 2019

No.	ACBM/Assumed ACBM Description	Functional Space Location	Friability	Assess. Category	Quantity	Comments	Recommended Response Action	Recommended Completion Date
4	Pipe Insulation	Boiler Room Kitchen, Gym Storage/Crawlspace Room # 29 - Back Wall, Above Hallway Ceilings Storage Room # 31	F	5	1,128 LF	Good Condition	The LEA shall attach labels indicating asbestos containing materials (ACM) on the material where they will clearly be noticed by employees who are likely to be exposed working in those areas.	June 10, 2019
5	Fitting Insulation	Boiler Room Assembly Room Roof Drain	F	5	157 EA	Good Condition	The LEA shall attach labels indicating asbestos containing materials (ACM) on the material where they will clearly be noticed by employees who are likely to be exposed working in those areas.	June 10, 2019
6	9” x 9" Floor Tile	Lower Level: Assembly Room # 29, PTA Kitchen Hallway, Gym & Assembly Middle Level: Kindergarten # 18, Teacher's Lounge, Middle Hallway, Supply room 24, Nurse's Office, Administrative Office Front & Rear lobbies Upper Level: Hallways, Under Carpeting in Conference Rooms and in all Classrooms 1 - 15 (carpeted) Kindergarten # 25	NF	5	4,800 SF	Good Condition	Maintain asbestos-containing flooring in accordance with EPA and OSHA guidelines. Use low speed buffers (<300 rpm). Maintain good wax coatings on flooring. Use low abrasion buffing pads. Do not sand, drill, cut, or otherwise disturb asbestos-containing flooring	NA

No.	ACBM/Assumed ACBM Description	Functional Space Location	Friability	Assess. Category	Quantity	Comments	Recommended Response Action	Recommended Completion Date
7	12” x 12" Floor Tile	Kitchen	NF	5	296 SF	Good Condition	Maintain asbestos-containing flooring in accordance with EPA and OSHA guidelines. Use low speed buffers (<300 rpm). Maintain good wax coatings on flooring. Use low abrasion buffing pads. Do not sand, drill, cut, or otherwise disturb asbestos-containing flooring	NA
8	Vinyl Counter Tops	Each classroom at perimeter univents	NF	5	250 SF	Good Condition	Maintain asbestos-containing counter tops in accordance with EPA and OSHA guidelines.	NA

AHERA ACBM assessment categories used in Table 3:

1 = Damaged or significantly damaged thermal system insulation (TSI) ACBM
2 = Damaged friable surfacing ACBM
3 = Significantly damaged friable surfacing ACBM
4 = Damaged or significantly damaged friable miscellaneous ACBM
5 = ACBM with potential for damage
6 = ACBM with potential for significant damage
7 = Any remaining friable ACBM or friable suspected ACBM
X = Not categorized (material is non-ACBM or non-friable surfacing or misc. material)
N/A = Not applicable (material removed or could not be located)
F = Friable, NF = Non-Friable

Condition Assessment Definitions in Table 3:

Significantly Damaged ACBM is defined as material observed to have greater than (>) 10% of its total area damaged OR greater than (>) 25% of localized damage.
Damaged ACBM is defined as material observed to have less than (<) 10% of its total area damaged OR less than (<) 25% of localized damage.
Minor Damage is defined as materials where some damage has been identified, but the damage (in the opinion of the inspector) is less severe than materials noted as damaged as defined above.
Good Condition is defined as material observed to have less than (<) 1% of its total area damaged AND less than (<) 1% of localized damage.

Table 4 – Summary of Abatement Activities 2009-2015

Date	Material	Quantity
7/2/2016	Breeching Insulation Pipe Insulation	200 SF 50 LF
6/29/2018	Vinyl Asbestos Tile and Mastic	60 SF

Table 5. Evaluation of Resources
Horace Mann Elementary School Newtonville, MA
January 10, 2019

A. Response Action Costs:

The following are order-of-magnitude budget costs for implementation of asbestos abatement response action recommendations as a result of the 2019 Re-inspection.

Asbestos Design:		$1,000
Air Monitoring		$3,000
ACM Repair/Removal		$12,000
	TOTAL	$16,000

B. Equipment Costs (Optional):

Equipment to perform O&M activities will only be needed if the employees have completed the 16-hour O&M training and are in the respiratory protection program. The trained employees can perform very small projects that will disturb asbestos. Specifically, O&M-trained employees can do work that involves no more than 3 linear feet or 3 square feet, and the asbestos removed must be confined to one standard asbestos waste bag. The equipment needed with estimated cost of items is as follows:

1)	HEPA filtered vacuum	$1,000
2)	HEPA vacuum disposable bags – 5/pkg.	$15
3)	6-mil plastic waste disposal bags – 25/cs.	$20
4)	6-mil plastic sheeting - roll of 12’ x 100’	$35
5)	Asbestos warning sign – 20/pkg.	$5
6)	Duct tape – 1 roll	$10
7)	Garden spray bottle	$30
8)	Wetting agent – 1 gallon	$30
9)	Half-mask-dual-cartridge respirator	$20
10)	HEPA filtered cartridges for respirators-6/pkg.	$30
11)	Tyvek disposable suits – 25/cs.	$100
	Total	$1,295

C. Asbestos Training Costs

2-hour awareness training is required for the Designated Person and all maintenance personnel. The estimated cost for course attendance per person is $100.

The Designated Person can also receive additional training by reviewing the EPA’s Designated Person Self Study Guide (a copy is enclosed).

D. Ongoing Management Costs:

The following are approximate costs for on-going management of the identified ACBM:

- Labeling $500
- 6-Month Surveillance $600
- 3-Year Re-inspection $900/3-Year Period

APPENDIX A
AHERA Schedule of Activities, 2019 - 2022

APPENDIX A

AHERA Schedule of Activities, 2019 - 2022
Horace Mann Elementary School, Newtonville, MA

Date (not later than)	Action
June 10, 2019	Labelling needs to be completed.
June 10, 2019	All response actions need to be completed
July 10, 2019	6-month periodic surveillance to be performed
September 1, 2019	Issue annual written notification of availability of the Management Plan
January 10,2020	6-month periodic surveillance to be performed
July 10, 2020	All response actions need to be completed
September 1, 2020	Issue annual written notification of availability of the Management Plan
January 10, 2021	6-month periodic surveillance to be performed
July 10, 2021	6-month periodic surveillance to be performed Issue annual written notification of availability of the Management Plan
September 1, 2021	Issue annual written notification of availability of the Management Plan
January 10, 2022	3-year Re-inspection to be performed

APPENDIX B
Supplemental AHERA Information

Appendix B. Supplemental AHERA Information for the Education Agency

The asbestos re-inspection that was recently completed in your school building(s) by FLI Environmental, Inc. was performed to comply with the AHERA regulation. It will be necessary to repeat the re-inspection(s) every three years until all known asbestos has been removed from the building or until the building is no longer used as a school.

AHERA stands for the Asbestos Hazard Emergency Response Act. This Act was signed into law on October 22, 1986 by President Reagan. It established the framework for a regulation which requires, among other things, that elementary and secondary schools identify asbestos containing materials in school buildings, institute programs aimed at minimizing the risk of asbestos exposure in those buildings, and re-inspect those materials every 3 years.

Asbestos is a naturally occurring fibrous mineral used in many building materials, primarily for fireproofing, thermal system insulation, sound insulation, flooring, and decoration. Materials that contain more than one percent asbestos are referred to as asbestos containing materials (Massachusetts regulations include materials that have one percent or greater asbestos). Inhalation of airborne asbestos fibers, which can be released by damaged or deteriorated asbestos containing materials in school buildings, has been shown to pose a health risk to building occupants.

The results of the most recent 3 year re-inspection have been presented in a written report. The report contains important information on the condition of all known asbestos containing materials in the school and presents a list of recommendations, referred to as Response Actions, that the Local Education Agency should implement to ensure that asbestos containing materials do not present a health risk. A Local Education Agency is an agency at the local level that exists primarily to operate schools or to contract for educational services for elementary and secondary public and non-profit private schools.

AHERA requires each Education Agency to designate a person, referred to as the AHERA Designated Person, to ensure that the AHERA requirements are properly implemented. The Education Agency is required to provide the AHERA Designated Person with adequate training to perform the duties required by AHERA. One of the responsibilities of the AHERA Designated Person is to review the re-inspection findings and implement the Response Actions included in the findings. The name of the Designated Person is indicated in Table 1 FLI's re-inspection report. Response Action recommendations and recommended completion dates are presented in Table 3 of FLI's re-inspection report.

During the initial AHERA inspections, many of the suspect materials in schools were assumed to be asbestos containing building materials, rather than sampling the materials to determine the asbestos content. In some instances, it may be advantageous for the Local Education Agency to sample these assumed asbestos containing to determine their asbestos content. For example, during the initial AHERA inspections, wall plaster was frequently assumed to be an asbestos containing material, even though this material often times does not contain asbestos. If wall plaster is determined to be damaged during a re-inspection, response action consisting of

removal or repair must be implemented. Sampling of the material may reveal that it does not contain asbestos, significantly reducing the cost of removal or repair. Of course, if the material is determined contain asbestos then the response action must still be completed.

The AHERA Designated Person is responsible for ensuring that the various AHERA related documents or records are maintained on file as part of each school's Management Plan. A Management Plan is a document(s) that each Education Agency is required to prepare under AHERA regulations. It describes all activities planned and undertaken by a school to comply with AHERA regulations, such as building inspections to identify asbestos containing materials, response actions, and operations and maintenance programs to minimize the risk of exposure to asbestos in school buildings. In practice, each school's Management Plan should consist of various documents, reports, letters, etc. organized into files that are kept at the Local Education Agency administrative offices with duplicates kept at each school building. FLI inspectors perform a limited review of each school's records during each re-inspection. The results of the review are presented in Table 2 of FLI's re-inspection report.

The following pages of this Appendix are copied from the United States Environmental Protection Agency Document "A Guide To Performing Re-inspections Under The Asbestos Hazard Emergency Response Act (AHERA)" dated February 1992. The information reproduced and included in this Appendix includes a sample re-inspection notification letter for parents and staff, and a glossary of terms.

GLOSSARY OF TERMS

ACBM **Asbestos-containing building material.** Which includes surfacing material, thermal system insulation, or miscellaneous material that is found in or on interior structural members or other parts of a building.

ACBM Condition **Good:** No visible damage or deterioration, or showing only very limited damage or deterioration.

Damaged: Physical injury or deterioration such that the internal structure of the material is inadequate, material which has delaminated such that its bond to the substrate is inadequate, or which lacks fiber cohesion or adhesion properties for any other reason. Thermal system insulation (TSI) is considered damaged when it is lacking part or all of its covering. Such damage may be shown by the separation of ACM into layers; flaking, blistering, or crumbling; water damage or stains; scrapes, mars or gouges; exposed TSI beneath its covering.

Significantly Damaged: Damage that is extensive and severe.

Administrator (EPA) The person appointed by the President to run the EPA.

AHERA The Asbestos Hazard Emergency Response Act. This Act was signed into law on October 22, 1986 by President Reagan. It established the framework for a regulation which requires, among other things, that elementary and secondary schools identify asbestos-containing materials in school buildings, institute programs aimed at minimizing the risk of asbestos exposure in those buildings, and re-inspect those materials at least every 3 years.

AHERA/regulation/rule 40 CFR 763, Asbestos-Containing Materials in Schools: Final Rule and Notice, U.S. Environmental Protection Agency, February, 1987.

AHERA 1-7 Categories Seven categories defined in the AHERA regulations, one of which must be assigned to each friable surfacing and miscellaneous ACBM and each asbestos-containing TSI during an inspection or re-inspection.

1. Damaged or significantly damaged TSI ACBM.
2. Damaged friable surfacing ACBM.
3. Significantly damaged friable surfacing ACBM.
4. Damaged or significantly damaged friable miscellaneous ACBM.
5. ACBM with potential for damage.
6. ACBM with potential for significant damage.
7. Any remaining friable ACBM or friable suspected ACBM.

AHERA Designated Person/Designated Person	Person designated by the Local Education Agency to ensure that the AHERA requirements are properly implemented.
Asbestos	Naturally-occurring fibrous mineral used in many building materials, primarily for fireproofing, thermal system insulation, sound insulation, and decoration.
Asbestos-containing	Any material, when referring to school buildings, which contains more than one percent asbestos.
Assessment	Evaluation of the physical condition and potential for damage of all friable ACBM and asbestos-containing thermal system insulation. AHERA requires classification of each ACBM assessed into one of seven categories based on material type and damage/potential for damage.
Assumed ACBM	Suspect building material that has not been sampled and analyzed for asbestos content and must, therefore, be treated as an ACBM by the LEA.
Bulk Sample	A small portion (usually about thumbnail size) of a suspect asbestos-containing building material collected by the inspector for laboratory analysis to determine asbestos content.
Completed Reinspection	The entire process of the visual examination and assessment of known and assumed ACBM in a school building; recommended response actions by the management planner; and submission of re-inspection findings and recommendations to the designated person. Re-inspections are required by AHERA every 3 years after management plan implementation.
Current Accreditation	Having successfully completed an EPA-approved accreditation or refresher course within 1 year of the re-inspection (for inspectors) or the management plan review (for management planners).
Encapsulation	Treatment of asbestos-containing material with a liquid that covers the surface with a protective coating or embeds fibers in an adhesive matrix to prevent the release of asbestos fibers.
Enclosure	An airtight, impermeable, permanent barrier around asbestos-containing material to prevent the release of fibers.
EPA	U.S. Environmental Protection Agency.
Evaluation Study	An EPA report entitled Evaluation of the Asbestos Hazard Emergency Response Act (AHERA).

Exclusion	One of several situations which permit the LEA to delete one or more of the items required by AHERA. For example, records of previous sample collection and analysis may be used by the accredited inspector in lieu of AHERA bulk sampling.
Exterior Areas	Subdivision of areas of a building with one or more walls open to the outside, such as covered walkways or porticos.
Form	Any document the inspector uses to record information for the re-inspection, or for inspection of previously unidentified materials. Two forms were developed for this re-inspection guide: ***Sample Re-inspection Form 1.*** Original AHERA Inspection Information Abstracted from the Management Plan. ***Sample Re-inspection Form 2.*** Re-inspection of ACBM: Findings and Management Planner Recommendations.
Friable	When referring to a school building, material that, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure. Includes previously non-friable material after it becomes damaged to the extent that, when dry, it may be crumbled, pulverized, or reduced to powder by hand pressure.
Functional Space	Under AHERA, a room, group of rooms, or homogeneous area designated by a person accredited to prepare management plans, design abatement projects, or conduct response actions.
HEPA	**High Efficiency Particulate Air.** A special type of filter used in equipment for removing asbestos fibers, e.g., vacuums, air filtration devices.
Homogeneous Sampling Area	In accordance with AHERA definitions, an area of surfacing material, TSI, or miscellaneous material that is uniform in color and texture.
HVAC	Heating, Ventilation and Air-Conditioning systems in a building.
Identified Material	Any AHERA-defined suspect material found during the original AHERA inspection that was also recorded in the management plan for the building.
Local Education Agency	An educational agency at the local level that exists primarily to operate schools or to contract for educational services for elementary and secondary public and non-profit private schools. For non-profit private schools, this includes the building owner.
Management Plan	A document that each Local Education Agency is required to prepare under AHERA regulations. It describes all activities planned and undertaken by a

	school to comply with AHERA regulations, such as building inspections to identify asbestos-containing materials, response actions, and operations and maintenance programs to minimize the risk of exposure to asbestos in school buildings.
Material Category	Broad classification of suspect materials into TSI, surfacing material, and miscellaneous material.
Miscellaneous Material	Interior building material on structural components, such as floor or ceiling tiles. Does not include TSI or surfacing material.
NESHAP	National Emission Standards for Hazardous Air Pollutants, EPA rules under the Clean Air Act.
Non-friable	Material that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
Operations and Maintenance Program (O&M)	Program of work practices to maintain friable ACBM in good condition, ensure cleanup of asbestos fibers previously released, and prevent future release by minimizing and controlling friable ACBM disturbance or damage.
Original AHERA Inspection/Original Inspection	Examination of school buildings arranged by Local Education Agency, pursuant to AHERA, to initially identify asbestos containing materials, evaluate the condition of those materials, and take samples of materials suspected to contain asbestos. Inspections are performed by inspectors accredited by the EPA or by EPA-approved State accreditation programs.
Periodic Surveillance	A visual examination for any change in material condition of ACBM and assumed ACBM in a school building. AHERA requires a periodic surveillance at least once every 6 months.
Previously Unidentified Material	Any AHERA-defined suspect material present in a building at the time of the original AHERA inspection that is not reported in the management plan.
Recorded Location	An area in which a suspect material was present during the inspection, and which is indicated in the management plan as having the material present.
Reinspection	The re-examination, by an accredited inspector, of a school building for which an original AHERA inspection was previously performed, including a re-evaluation and response action recommendations by an accredited management planner. Re-inspection of school buildings containing ACBM is required by AHERA regulations at least once every 3 years.

Removal	Taking out or stripping ACBM from an area, a functional space, or a homogeneous area.
Repair	Procedures used to patch or cover damaged asbestos-containing materials, other than enclosure or encapsulation. Examples include covering the damage with plastic sheeting, duct tape, or plaster.
Resilient Sheeting Flooring/Linoleum	A type of floor covering which is preformed in long sheets. Generally, the sheets are unrolled and secured to the floor with an adhesive. These commonly have a vinyl-based upper surface. The backing may contain asbestos.
Response Actions	Methods, including removal, encapsulation, enclosure, repair, and operations and maintenance, that protect human health and the environment from friable ACBM.
Room/Area	A well-defined space within a building, generally a distinct room, but also a hall, crawlspace, or other distinct space. This term may refer to the entire homogeneous sampling area or to a functional space but is generally a subset of these.
School Building	Any structure essential to the operation of a school and under the authority of the LEA, including classrooms, student housing, athletic facilities, administrative areas, garages, and maintenance areas. Several buildings may be present at one school.
Surfacing Material	Material sprayed or troweled onto structural members (beams, columns, or decking) for fire protection; or on ceilings or walls for fireproofing, acoustical or decorative purposes. Includes fireproofing, textured plaster, and other textured wall and ceiling surfaces.
Suspect Material	Building material suspected to contain asbestos because of past practices in its manufacture and use. Includes surfacing material, gypsum wallboard (also called sheetrock or drywall), floor tile, ceiling tile, thermal system insulation, and miscellaneous other materials. Suspect materials are classified as ACBM or non-ACBM by analyzing bulk samples to determine asbestos content.
Total Amount	Estimated amount (in square or linear feet) of suspect material in a building(s) at the time of the original AHERA inspection.
TSI	***Thermal System Insulation***. Material in a school building applied to pipes, fittings, boilers, breeching, tanks, ducts or other interior structural components to prevent heat loss or gain, or water condensation, or for other purposes.

Underestimated Quantity	The difference between the total amount of a suspect material found during the Evaluation Study and the amount of the same material recorded in the management plan, when the latter quantity is less than 80 percent of the former.
Vibration Dampening Cloth (VDC)	Cloth commonly found on ductwork where duct size changes used to reduce noise.
Wallboard	Generic term for any wall surface installed as sheets, rather than applied wet. Includes gypsum wallboard (also called sheetrock or drywall), Transite panels, etc.

APPENDIX D
6-Month Survey Forms

Franklin Elementary School
AHERA
6-Month Periodic Surveillance
____/___/___

Material Type Description	Functional Space/Location	Previous Condition	Condition Change	Current Damage Assessment	Recommendations/Comments
Boiler Insulation	Boiler Room		Yes No Abated Other	None Water Physical Other	
Breeching Insulation	Boiler Room		Yes No Abated Other	None Water Physical Other	
Generator Insulation	Boiler Room		Yes No Abated Other	None Water Physical Other	
Pipe Insulation	Boiler Room Kitchen, Gym Storage/Crawlspace Room # 29 - Back Wall, Above Hallway Ceilings Storage Room # 31		Yes No Abated Other	None Water Physical Other	
Fitting Insulation	Boiler Room Assembly Room Roof Drain		Yes No Abated Other	None Water Physical Other	

Inspection Completed By: _____

Signed: _____ Date: _____

Franklin Elementary School
AHERA
6 Month Periodic Surveillance
____/___/___

Material Type Description	Functional Space/Location	Previous Condition	Condition Change	Current Damage Assessment	Recommendations/Comments
9” x 9" Floor Tile	Lower Level: Assembly Room # 29, PTA Kitchen Hallway, Gym & Assembly Middle Level: Kindergarten # 18, Teacher's Lounge, Middle Hallway, Supply room 24, Nurse's Office, Administrative Office Front & Rear lobbies Upper Level: Hallways, Under Carpeting in Conference Rooms and in all Classrooms 1 - 15 (carpeted) Kindergarten # 25		Yes No Abated Other	None Water Physical Other	
12” x 12" Floor Tile	Kitchen		Yes No Abated Other	None Water Physical Other	
Vinyl Counter Tops)	Each classroom at perimeter univents		Yes No Abated Other	None Water Physical Other	

Inspection Completed By: _____

Signed: _____ Date: _____

AQUA BARRIERS, INC. – Roofing Contractor: email: chris@aquabarriers.net
P.O. Box 95, Norfolk, MA. 02056 PH (508) 520-1859 / Fax (508) 520-3407

LEAK INVESTIGATION / ROOFING SERVICES REPORT **Date:** 10/9/18

Job Name: Horace Mann School **Address:** Watertown St., Newton, MA

Start Time: 12:00 * **Note:** If you are a First Call, the men start at 6:15 am. Your Time includes
End Time: 3:15 their prep and one-way travel.
Time on Job: _____

SIGNATURE OF ON SITE PERSONNEL: Paul Fiedler

*We cannot guarantee portions of the roof, which we did not repair. If leakage occurs in such areas, any repairs will be billed separately. PAUL FIEDLER

ESTIMATE NO. _____

CREW FOREMAN: Luc

CREW : Evan, _____, _____

Job Site Weather Conditions: Sunny | 70s
Deck Type: Tectum
Ballasted: _____ **UnBallasted:** _____
Membrane Type T&G
Membrane Thickness: _____
Access to Roof: Yes X **No** _____
Have we been here before for the same leak?
Yes _____ **No** _____

T&M: _____
Proposal No: _____
Does Roof Currently have a Warranty?
Yes _____ **No** _____
Is work Completed under Warranty?
Yes _____ **No** _____
Was a Flood Test performed?
Yes _____ **No** _____

During our investigation we noted and made the following repairs:

- [ ] Patched Field Seams
- [ ] Repaired Base Flashing Detail at Curb/Wall
- [ ] Patched existing patches that were open or failed
- [ ] Repaired edge detail using 6-9" Elastaform
- [ ] Repaired Roof Drain
- [ ] Repaired Pitch Pocket
- [ ] Cut out Contaminated Membrane
- [ ] HVAC Unit Leaking
- [ ] False Alarm No Roof Leaks
- [ ] Installed New Penetration (Describe below)
- [ ] Removed Wet or Damaged Insulation
- [ ] Wall / Masonry Repairs
- [X] Test Cuts
- [ ] Patched Cuts or Punctures caused by Physical Damage

Added Description (if needed): Test cut in field - 4 1/2" to deck
Testcut at edge - 9 1/2" to deck.

Additional Work / Measurements Necessary: _____

Aqua Barriers, Inc.
P.O. Box 95
Norfolk, MA 02056
info@aquabarriers.net
(508) 520-1859 / (508) 520-3407

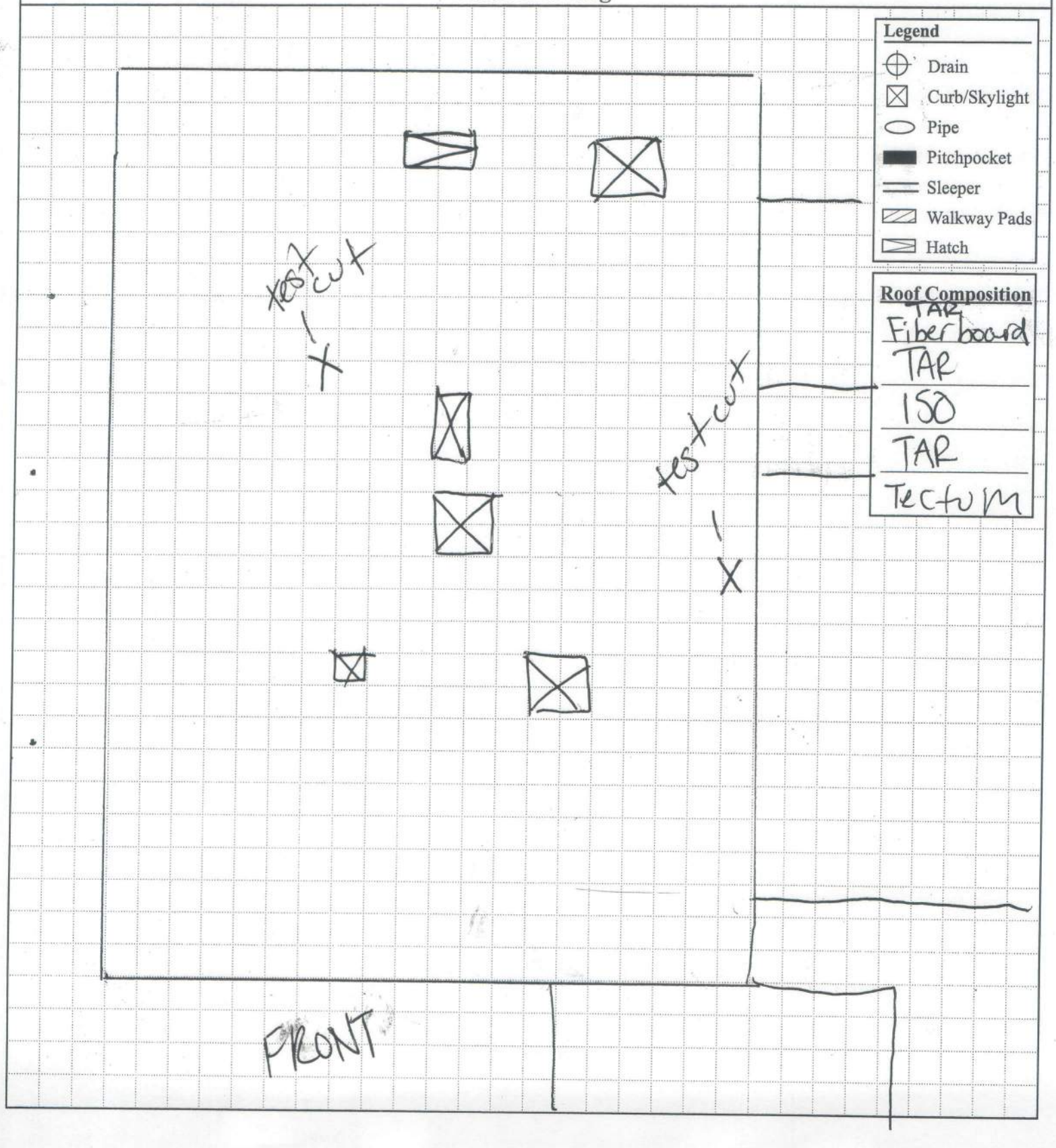
Job Name: _____

Address: _____

_____

Date: _____

Roof Drawing



EMSL Analytical, Inc.

5 Constitution Way, Unit A Woburn, MA 01801

Tel/Fax: (781) 933-8411 / (781) 933-8412

http://www.EMSL.com / bostonlab@emsl.com

EMSL Order:	131807250
Customer ID:	UEC63
Customer PO:	
Project ID:	

Attention:	Ammar Dieb	**Phone:**	(617) 984-9772
	Universal Environmental Consultants	**Fax:**	(508) 628-5488
	12 Brewster Road	**Received Date:**	10/10/2018 12:20 PM
	Framingham, MA 01702	**Analysis Date:**	10/11/2018
		Collected Date:	10/09/2018
Project:	Horace Mann School / Newton, MA		

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
1 *131807250-0001*	Office - Tectum Deck	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2 *131807250-0002*	Teachers Room - Tectum Deck	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
3 *131807250-0003*	Room 126 - Tectum Deck	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
4 *131807250-0004*	Pipe Penetration - Roofing Pipe Tar	Black Fibrous Homogeneous	7% Glass	88% Non-fibrous (Other)	5% Chrysotile
5 *131807250-0005*	Pipe Penetration - Roofing Pipe Tar	Black Fibrous Homogeneous	15% Cellulose	85% Non-fibrous (Other)	None Detected
6 *131807250-0006*	Vent Penetration - Roofing Vent Tar	Black Fibrous Homogeneous		87% Non-fibrous (Other)	13% Chrysotile
7 *131807250-0007*	Vent Penetration - Roofing Vent Tar	Black Fibrous Homogeneous		96% Non-fibrous (Other)	4% Chrysotile
8 *131807250-0008*	Chimney Penetration - Roofing Chimney Tar	Black Fibrous Homogeneous	15% Cellulose	85% Non-fibrous (Other)	None Detected
9 *131807250-0009*	Cut 1 Layer 1 - Roofing Tar	Tan/Black Fibrous Homogeneous	12% Cellulose 8% Glass	80% Non-fibrous (Other)	None Detected
10 *131807250-0010*	Cut 1 - Fiberboard	Tan Fibrous Homogeneous	80% Cellulose	20% Non-fibrous (Other)	None Detected
11 *131807250-0011*	Cut 1 Layer 2 - Roofing Tar	Black/Yellow Fibrous Homogeneous	10% Glass	90% Non-fibrous (Other)	None Detected
12 *131807250-0012*	Cut 1 Layer 3 on Deck - Roofing Tar	Black/Yellow Fibrous Homogeneous	10% Glass	90% Non-fibrous (Other)	None Detected
13 *131807250-0013*	Cut 2 Layer 1 - Roofing Tar	Black/Yellow Fibrous Homogeneous	15% Cellulose 45% Glass	40% Non-fibrous (Other)	None Detected
14 *131807250-0014*	Cut 2 Layer 2 - Roofing Tar	Black/Yellow Fibrous Homogeneous	5% Cellulose 10% Glass	85% Non-fibrous (Other)	None Detected
15 *131807250-0015*	Cut 2 Layer 3 - Roofing Tar	Black/Yellow Fibrous Homogeneous	5% Cellulose 10% Glass	85% Non-fibrous (Other)	None Detected
16 *131807250-0016*	Cut 3 Layer 4 - Roofing Tar	Black Fibrous Homogeneous	12% Cellulose 5% Glass	83% Non-fibrous (Other)	None Detected

Initial report from: 10/11/2018 15:25:37

EMSL Analytical, Inc.
5 Constitution Way, Unit A Woburn, MA 01801
Tel/Fax: (781) 933-8411 / (781) 933-8412
http://www.EMSL.com / bostonlab@emsl.com

EMSL Order:	131807250
Customer ID:	UEC63
Customer PO:	
Project ID:	

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
17 *131807250-0017*	Cut 2 Layer 5 on Deck - Roofing Tar	Black Fibrous Homogeneous	20% Cellulose 5% Glass	75% Non-fibrous (Other)	None Detected

Analyst(s)
Kevin McKenzie (17)

Steve Grise, Laboratory Manager
or Other Approved Signatory

Initial report from: 10/11/2018 15:25:37

OrderID: 131807250

131807250

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: Newton, MA Building Name: Horace Mann School

Sample	Result	Description of Material	Sample Location
1		Tectum deck	office
2		"	Teachers room
3		"	Room 126
4		Roofing Pipe tar	Pipe penetration
5		"	"
6		Roofing vent tar	vent Penetration
7		"	"
8		Roofing chimney tar	chimney penetration
9		Roofing tar	Cut 1 Layer 1
10		Fiber board	Cut 1
11		Roofing tar	Cut 1 Layer 2
12		"	Cut 1 Layer 3 on deck
13		"	Cut 2 Layer 1
14		"	Cut 2 Layer 2
15		"	Cut 2 Layer 3
16		"	Cut 2 Layer 4
17		"	Cut 2 Layer 5 on deck

Reported By: Jason Berotte Date: 10-9-18 Due Date:

Received By: Date:

REC'D AF 12:20 pm
EMSL-BOSTON OCT 10 2018

UNIVERSAL ENVIRONMENTAL CONSULTANTS

Asbestos Identification Laboratory

165 New Boston St., Ste 227
Woburn, MA 01801
781-932-9600

Web: www.asbestosidentificationlab.com
Email: mikemanning@asbestosidentificationlab.com

Batch: 52402

NVLAP® Lab Code: 200919-0

April 30, 2020

Ammar Dieb
Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702

Project Name: *687 Watertown Street, Newton, MA*
Project Number:
Date Sampled: 2020-04-29
Work Received: 2020-04-29
Work Analyzed: 2020-04-30

Analysis 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 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

April 30, 2020

Ammar Dieb
Universal Environmental Consultants
12 Brewster Road
Framingham, MA 01702

Project Name: *687 Watertown Street, Newton, MA*
Project Number:
Date Sampled: 2020-04-29
Work Received: 2020-04-29
Work Analyzed: 2020-04-30

Analysis Method: BULK PLM ANALYSIS EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
1 / 584926	Textured Soffit Plaster	Exterior Overhang	gray	Non-Fibrous 100	None Detected
2 / 584927	Textured Soffit Plaster	Exterior Overhang	gray	Non-Fibrous 100	None Detected
3 / 584928	Textured Soffit Plaster	Exterior Overhang	gray	Non-Fibrous 100	None Detected
4 / 584929	Black Coating Inside Speaker Box	Room 213	black	Non-Fibrous 90	Detected Chrysotile 10
5 / 584930	Black Coating Inside Speaker Box	Room 213	black	Non-Fibrous 90	Detected Chrysotile 10
6 / 584931	Foundation Damp Proofing	Exterior	black	Non-Fibrous 90	Detected Chrysotile 10
7 / 584932	Foundation Damp Proofing	Exterior	black	Non-Fibrous 90	Detected Chrysotile 10
8 / 584933	Ceramic Wall Tile Glue	Room 131 Bathroom	tan	Non-Fibrous 100	None Detected
9 / 584934	Ceramic Wall Tile Glue	Boilewr Room Bathroom	tan	Non-Fibrous 100	None Detected
10 / 584935	Black Sink Coating	Room 208	black	Non-Fibrous 95	Detected Chrysotile 5
11 / 584936	Gray Sink Coating	Room 213	gray	Non-Fibrous 100	None Detected
12 / 584937	Gray Sink Coating	Room 131	gray	Non-Fibrous 100	None Detected
13 / 584938	Carpet Glue	Room 131	tan	Non-Fibrous 100	None Detected
14 / 584939	Carpet Glue	Room 205	tan	Non-Fibrous 100	None Detected

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
15 / 584940	Damp Proofing on CMU Wall	Gym Exterior Wall	black	Non-Fibrous 90	**Detected** Chrysotile 10
16 / 584941	Damp Proofing on CMU Wall	Gym Exterior Wall	black	Non-Fibrous 90	**Detected** Chrysotile 10
17 / 584942	Tan Paper Under Hardwood	Gym	tan	Cellulose 80 Non-Fibrous 20	None Detected
18 / 584943	Tan Paper Under Hardwood	Gym	tan	Cellulose 80 Non-Fibrous 20	None Detected
19 / 584944	Damp Proofing on Slab Under Wood	Gym	black	Non-Fibrous 100	None Detected
20 / 584945	Damp Proofing on Slab Under Wood	Gym	black	Non-Fibrous 90	**Detected** Chrysotile 10
21 / 584946	Old Black Mastic Under 12x12	Hallway at 206-211	black	Non-Fibrous 95	**Detected** Chrysotile 5
22 / 584947	Black Mastic Under 12x12	Room 131	black	Cellulose 5 Non-Fibrous 93	**Detected** Chrysotile 2

Thursday 30 April

End of Report

Analyzed by:

Batch: 52402

CHAIN OF CUSTODY

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PLM
24-hour TAT

Town/City: Newton, MA Building Name 687 Watertown Street

Sample	Result	Description of Material	Sample Location
1		Textured Soffit Plaster	Exterior overhang
2		" "	" "
3		" "	" "
4		Black coating inside SpeakerBox	Room 213
5		" "	" "
6		Foundation Dampproofing	exterior
7		" "	" "
8		Ceramic wall tile glue	Room 131 Bathroom
9		" "	Boiler room Bathroom
10		Black sink coating	Room 208
11		Gray sink coating	Room 213
12		" "	Room 131
13		carpet glue	Room 131
14		" "	Room 205
15		Dampproofing on CMU wall	Gym exterior wall
16		" "	" "
17		Tan Paper under Hardwood	Gym
18		" "	" "
19		Dampproofing on slab underwood	Gym
20		" "	" "

Reported By: Jason Beaulieu Date: 4-29-20 Due Date: ----------

Received By: Michael Adams Date: 4/29/20

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: Newton, MA Building Name 687 Watertown Street

Sample	Result	Description of Material	Sample Location
21		old Black mastic under 12x12	Hallway at 206-211
22		Black mastic under 12x12	Room 131

Reported By: Jason Becotte Date: 4-29-20 Due Date: ----------

Received By: AMM Date: 4/29/20