

**PROJECT MANUAL**

# **ORLEANS COMMUNITY BUILDING**

44 MAIN STREET  
ORLEANS, MA

CONSTRUCTION DOCUMENTS  
MARCH 11, 2022

ARCHITECT  
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PROJECT MANUAL

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\* Filed Sub-Bid Required

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\* Filed Sub-Bid Required

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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 PROJECT REQUIREMENTS

- A. Project Identification: Orleans Community Building, Orleans, MA.
- B. Project Description: The Orleans Community Building is a historic 1926 firehouse in Orleans, MA that has since been converted for community uses. The building currently serves as the visitor's center/chamber of commerce and includes public restrooms, meeting rooms and function hall. ICON will be upgrading the building with new public spaces and toilet rooms. We will be demoing to the studs at the interiors and relocating the public restrooms from the north facing side to the east. ICON intends to introduce new wood porches at the east and west sides of the building along with a new cantilevered roof covering Theresa's Way on the North side. Existing stairs to the basement and attic will be demolished and replaced with a relocated stair to the basement and a ship ladder for access to the attic space. A folding Nanawall panel system will be included at the west facade to open the function hall to Main St. and resemble the appearance of the historic garage bay door. The panel system at the apparatus bay will include operable French doors, while the glazing at the historic ambulance bay (addition in 1947) will be a fixed panel system.
- C. Project Requirements for Temporary Utilities and Facilities:
1. Utility Costs: The Owner will allow the use of existing utility systems and pay for cost of utility services consumed, including electricity, water and gas. Do not waste. The Contractor shall provide and pay for temporary heat prior to the complete enclosure of the building and availability of suitable permanent systems.
  2. Temporary Offices: A separate field office for the Architect and the Owner's Representative is not required.
  3. Toilet Facilities: The Contractor shall provide and maintain temporary toilets outside the building.

GENERAL REQUIREMENTS

- D. Permits and Fees: Apply for, obtain, and pay for permits, fees, and utility company backcharges required to perform the work. Submit copies to Architect.
- E. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submit copies of inspection reports, notices and similar communications to Architect.
- F. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.
- G. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings.
- H. Contractor's Conduct on Premises: The Contractor and their employees shall behave in a respectful, courteous and safe manner. Abusive, harassing, and lewd behavior is prohibited. Music playing is prohibited. Alcohol, tobacco, and drug use is prohibited.

### 1.3 SPECIFICATION INFORMATION

- A. These specifications are a specialized form of technical writing edited from master specifications and contain deviations from traditional writing formats. Capitalization, underlining and bold print is only used to assist reader in finding information and no other meaning is implied.
- B. Except where specifically indicated otherwise, the subject of all imperative statements is the Contractor.
- C. Sections are generally numbered in conformance with Construction Specifications Institute Masterformat System. Numbering sequence is not consecutive. Refer to the Table of Contents for names and numbers of sections included in this Project.
- D. Pages are numbered separately for each section. Each section is noted with "End of Section" to indicate the last page of a section.

### 1.4 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

#### 1.5 INDUSTRY STANDARDS

- A. Referenced standards are part of the Contract Documents and have the same force and effect as if bound with these specifications.
- B. Except where specifically indicated otherwise, comply with the current standard in effect as of the date of the Owner/Contractor Agreement. Obtain copies of industry standards directly from publisher.
- C. The titles of industry standard organizations are commonly abbreviated; full titles may be found in Encyclopedia of Associations or consult Architect.

#### 1.6 CODES AND REGULATIONS

- A. Comply with all applicable codes, ordinances, regulations and requirements of authorities having jurisdiction.
- B. Submit copies of all permits, licenses, certifications, inspection reports, releases, notices, judgments, and communications from authorities having jurisdiction to the Architect.
- C. COVID-19 Procedures: The Contractor shall submit a written plan for jobsite COVID-19 Procedures in compliance with applicable governmental regulations and as supplemented by the Contractor's own requirements, if any. Scope shall include that people and materials entering the site shall be required to comply with the written plan. Identify the Contractor's personnel responsible for implementing such procedures. For the record, submit a monthly statement certifying that the Contractor has enforced the provisions in its written plan. The Contractor acknowledges that its written plan and monthly statements are submitted for the record only and not for approval by neither the Owner nor the Architect nor their agents.

#### 1.7 PROGRESS SCHEDULE

- A. Provide comprehensive bar chart schedule showing all major and critical minor portions of the work, sequence of work and duration of each activity. Update and reissue regularly, but not less than monthly.

#### 1.8 SCHEDULE OF VALUES

- A. Prepare Schedule of Values to coordinate with application for payment breakdown. Submit at least 10 days before first payment application. Update and reissue regularly, but not less than monthly.

## 1.9 PAYMENT REQUESTS

- A. Provide three copies of each request on completely filled out copies of AIA G702 and continuation sheet G703. Substantiate requests with complete documentation; include change orders to date. Provide partial lien waivers for work in progress and full lien waivers for completed work.
- B. As-Constructed Record Drawing Certification: Certify as a part of each application for payment that the project as-constructed record documents are current at the time of application is submitted. The Contractor shall require such drawings to be current as a condition of approving any payment to the trade Contractor and Subcontractor.
- C. Before first payment application, provide the following:
  - 1. List of subcontractors, suppliers and fabricators.
  - 2. Schedule of values.
  - 3. Progress schedule.
  - 4. Submittal schedule keyed to project schedule.
  - 5. List of Contractor's key project personnel.
  - 6. Copies of permits and other communications from authorities.
  - 7. Contractor's certificate of insurance.
  - 8. Performance and payment bonds if required.
  - 9. Unit price schedule.
- D. Before final payment application, provide and complete the following:
  - 1. Complete closeout requirements.
  - 2. Complete punch list items.
  - 3. Settle all claims.
  - 4. Transmit record documents to Architect. Include statement that Architect's Supplemental Instructions, Change Orders, Construction Change Directives and minor changes in the work have been incorporated in the as-constructed record drawings.
  - 5. Prove that all taxes, fees and similar obligations have been paid.
  - 6. Remove temporary facilities and surplus materials.
  - 7. Change lock cylinders or cores.
  - 8. Clean the work.
  - 9. Submit consent of surety, if any, for final payment.

## 1.10 PROCEDURES AND CONTROLS

- A. Project Meetings: Arrange for and attend meetings with the Architect and such other persons as the Architect requests to have present. The Contractor shall be represented by a principal, project manager, general superintendent or other authorized main office representative, as well as by the Contractor's field superintendent. An authorized representative of any subcontractor or sub-subcontractor shall attend such meetings if the representative's presence is requested by the Architect. Such representatives shall be empowered to make binding commitments on all matters to be discussed at such meetings, including costs, payments, change orders, time schedules and manpower. Any notices required under the Contract may be served on such representatives. Written reports of meeting minutes shall be prepared by the Contractor and distributed by the Contractor to attendees, the Architect, and Owner within three business days.
  - 1. Pre-Construction Conference: Attendance by Architect, Contractor, major subcontractors. Agenda shall include: Quality of workmanship, coordination, interpretations, job schedule, submittals, approvals, requisition procedures, testing, protection of construction, indoor air quality, and construction waste management.

2. Exterior Envelope Meeting: Attendance by Architect, Contractor, major subcontractors. Agenda shall include as applicable: Review of exterior wall details, wall construction, sample panel preparation, cleaning, control and expansion joints, cold weather procedures.
  3. Roofing/Flashings Meeting: Attendance by Architect, Contractor, roofing subcontractor, and representative of roofing manufacturer. Agenda shall include as applicable: Preparation of roof decks, flashing and blocking details, roofing procedures and inspections, bonds and guarantees, weather conditions during roofing, protection of roof membrane during construction.
  4. Interior Finishes Meeting: Attendance by Architect, Contractor, major subcontractors. Agenda shall include as applicable: Quality of workmanship, environmental conditions for application of finishes, drywall details, millwork details, condition of surfaces to receive finishes, tile work, painting work, samples and test areas and approvals, coordination with mechanical and electrical interfaces and penetrations, indoor air quality.
  5. Progress Meetings: Hold regularly before preparation of payment requests and additional meetings as requested by the Architect. Attendance by Architect, Contractor, and others as determined by Contractor. Agenda shall include work in progress and payment requests.
  6. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction, as specified. Preinstallation Conferences may be part of Progress Meeting agenda. Attendance by Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow. Agenda shall include a review of progress of other construction activities and preparations for the particular activity under consideration.
- B. Emergency Contacts: Furnish the Owner and Architect, in writing, the names and telephone numbers of individuals to be contacted in the event of an out-of-hours emergency at the building site. Post a similar list readily visible from the outside of the field office or a location acceptable to the Architect.
- C. Layout: Layout work and be responsible for all lines, elevations, and measurements of the building, grading, utilities and other work executed under the contract. Retain a registered professional engineer or registered land surveyor, acceptable to the Architect, to initially establish exterior lines and required elevations of all buildings and structures to be erected on the site. The registered professional engineer or registered land surveyor shall certify the actual location of the constructed facilities in relation to property lines, building lines, easements, setbacks, and other restrictive boundaries.
- D. Field Measurements: Verify measurements at the building prior to ordering materials or commencing work. No extra charge or compensation will be allowed because of differences between actual dimensions and measurements indicated on the Drawings. Differences which may be found shall be submitted to the Architect for decision before proceeding with the work.
- E. Field Measurements for Fixed Equipment: Dimensions for fixed equipment to be supplied under this Contract or separate contracts shall be determined by field measurements taken jointly by the Contractor and the equipment supplier involved. A record of the field measurements shall be kept until time of substantial completion of the project, or until the equipment has been fully installed and accepted by the Owner, whichever is later. Responsibility for fixed equipment fabricated accurately to field measurements for proper fit and operation shall be that of the Contractor. Contractor shall pay all costs involved in correcting any misfitting fixed equipment as fabricated.
- F. Project Limit Line: The boundaries of the site do not limit the responsibility of the Contractor to perform the work in its entirety. Make utility connections as indicated.

- G. Matching: Where matching is indicated, the Architect shall be the sole and final judge of what is an acceptable match. Mockups and sample submissions are required.
- H. Observation: Notify the Architect and authorities having jurisdiction at least thirty-six hours in advance of concealing any work.
- I. Utilities: Prior to interrupting utilities, services or facilities, notify the utility owner and the Owner and obtain their written approval a minimum 48 hours in advance.
- J. Furnishings, Fixtures, and Equipment: Cooperate and permit the Owner to install their furnishings and equipment during the progress of the work. Owner's installation of furnishings or equipment does not signify Owner's acceptance of any portion of the work.
- K. Clean-Up: Frequently clean-up all waste, remove from site regularly, and legally dispose of off-site.
  - 1. Comply with requirements of Section 017400 - CONSTRUCTION WASTE MANAGEMENT.
- L. Installer's Acceptance of Conditions: All installers shall inspect substrates and conditions under which work is to be executed and shall report in writing to the Contractor all conditions detrimental to the proper execution and completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means installer accepts previous work and conditions.
- M. Coordination: The Contractor shall be fully responsible for coordinating all trades, coordinating construction sequences and schedules, and coordinating the actual installed location and interface of all work.
  - 1. Prior to beginning mechanical, electrical and fire protection work, the Contractor shall prepare coordination drawings showing the exact alignment, physical location and configuration of the mechanical, electrical and fire protection installations and demonstrating to the Contractor's satisfaction that the installations will clear all obstructions, permit proper clearances for the Work of other trades, and present an orderly appearance where exposed. The Contractor shall be solely liable and responsible for any costs and delays resulting from the Contractor's failure to prepare such coordination drawings or from the negligent preparation of such coordination drawings.
  - 2. Exact locations and groupings of mechanical, electrical and fire protection fixtures, switches, heads and outlets shall be obtained from the Architect before the Work is roughed in. Work installed without such information from the Architect shall be relocated at the Contractor's expense if the Architect so requests.
- N. Request For Interpretation (RFIs):
  - 1. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
    - a. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  - 2. Content of the RFI: Include a detailed, legible description of item needing interpretation.
  - 3. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow three working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
  - 4. The following RFIs will be returned without action:

- a. Requests for approval of submittals.
  - b. Requests for approval of substitutions.
  - c. Requests for coordination information already indicated in the Contract Documents.
  - d. Requests for adjustments in the Contract Time or the Contract Sum.
  - e. Requests for interpretation of Architect's actions on submittals.
  - f. Incomplete RFIs or RFIs with numerous errors.
- O. Existing Articles of Unusual Value: If during demolition, excavation, or disposal 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 Architect. If the nature of the article is such that work cannot proceed without danger of damage, work in the area shall be immediately discontinued until the Architect has determined the proper procedure to be followed. Delays in time thereby shall be a condition for which the time of the Contract may be extended. Costs incurred after discovery in the salvaging of such articles shall be borne by the Owner.

#### 1.11 SUBMITTALS

- A. Required Submittals: Submit shop drawings, product data, initial selection samples, verification samples, calculations, coordination drawings, schedules, and all other submittals as specified in individual specification sections.
- B. Submittal Schedule: Within 30 days after award of contract and before first application for payment, prepare list of submittals in chronological sequence showing all submittals and proposed date first due at Architect's office and proposed date due to be returned to Contractor. Note relevant specification section number.
- C. Contractor's Preparation of Submittals: Modify and customize all submittals to show interface with adjacent work and attachment to building. Identify each submittal with name of project, date, Contractor's name, subcontractor's name, manufacturer's name, submittal name, relevant specification section numbers, and Submittal Schedule reference number. Stamp and sign each submittal to show the Contractor's review and approval of each submittal before delivery to Architect's office; unstamped and unsigned submittals will be returned without action by the Architect. Leave 4" x 6" open space for Architect's "action" stamp.
1. Electronic Submittals: Provide a copy of all submittals in electronic format to the Architect. Architect will return a file of reviewed submittal in electronic format to the Contractor for distribution to subcontractors, suppliers, fabricators, governing authorities and others as necessary for proper performance of the Work. Unless otherwise amenable to the Architect, additional hard copies of submittals will not be reviewed by the Architect (or Consultant) and will not be returned to the Contractor.
  2. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  3. Name file with submittal number or other unique identifier, including revision identifier.
  4. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.
  5. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect.
- D. Product Data: Provide manufacturer's preprinted literature including, without limitation, manufacturer's standard printed description of product, materials and construction, recommendations for application and use, certification of compliance with standards, instructions for installation, and special coordination requirements. Collect data into one

submittal for each unit of work or system; mark each copy to show which choices and options are applicable to project.

1. Installer Copy: Verify that the Installer has a current copy of the relevant product data, including installation instructions, before permitting installation to begin.
- E. Shop Drawings: Provide accurately prepared, large scale and detailed shop drawings prepared specifically for this project. Show adjacent conditions and related work. Show accurate field dimensions and clearly note field conditions. Identify materials and products in the work shown. Note special coordination required.
1. After Architect's action, follow specified distribution procedure.
- F. Samples: Provide units identical with final materials and products to be installed in the work. Where indicated, prepare samples to match Architect's sample. Label each sample with description, source, generic name or manufacturer's name and model number. Architect will review samples for confirmation of visual design intent, color, pattern, texture and type only; Architect will not test samples for compliance with other Contract requirements which shall remain the exclusive responsibility of the Contractor.
1. Initial Selection Samples Submittal Quantities: For initial selection purposes, submit 1 set of samples showing the complete range of colors and finishes available.
  2. Verification Samples Submittal Quantities: For verification of an initial selection, submit 3 sets of samples; one set will be returned to Contractor to be maintained at project site for quality control comparisons.
- G. Timing of Submittals: Submit submittals in a timely fashion to allow at least 10 business days for each office's review and handling. This means that submittals which have to be reviewed by the Architect and one of their consultants require at least 20 business days for review and handling. Add ten business days for each additional consultant who must review a submission.
- H. Architect's Action on Submittals: Architect will review submittals, stamp with "action stamp", mark action, and return to Contractor. Architect will review submittals only for conformance with the design concept of the project. The Contractor is responsible for confirming compliance with other Contract requirements, including without limitation, performance requirements, field dimensions, fabrication methods, means, methods, techniques, sequences and procedures of construction, coordination with other work. The Architect's review and approval of submittals shall be held to the limitations stated in the Owner/Architect Agreement and the Conditions of the Contract. In no case shall approval or acceptance by the Architect be interpreted as a release of Contractor of their responsibilities to fulfill all of the requirements of the Contract Documents.
1. Required Resubmittal: Unless submittal is noted "reviewed" or "reviewed except as noted, resubmission not required," make corrections or changes to original and resubmit to Architect.
  2. Distribution: When submittal is noted "reviewed" or "reviewed as noted, resubmittal not required," make prints or copies and distribute to Owner, Subcontractors involved, and to all other parties requiring information from the submittal for performance or coordination of related work.
- 1.12 WARRANTIES
- A. Warranties Required: Refer to individual trade sections for specific product warranty requirements.

- B. Procurement: Where a warranty is required, do not purchase or subcontract for materials or work until it has been determined that parties required to countersign warranties are willing to do so.
- C. Warranty Forms: Submit written warranty to Owner through Architect for approval prior to execution. Furnish two copies of executed warranty to Owner for their records; furnish two additional conformed copies where required for maintenance manual.
- D. Work Covered: Contractor shall remove and replace other work of project which has been damaged as a result of failure of warranted work or equipment, or which must be removed and replaced to provide access to work under warranty. Unless otherwise specified, warranty shall cover full cost of replacement or repair, and shall not be pro-rated on basis of useful service life.
- E. Warranty Extensions: Work repaired or replaced under warranty shall be warranted until the original warranty expiration date or for ninety days whichever is later in time.
- F. Warranty Effective Starting Date: Guarantee period for all work, material and equipment shall begin on the date of substantial completion of the Project, not when subcontractor has completed their work nor when equipment is turned on. In addition to the one year guarantees for the entire work covered by these Contract Documents, refer to the various sections of the specifications for extended guarantee or maintenance requirements for various material and equipment.
- G. Warranties are Irrevocable: Warranties issued to the Owner are irrevocable.
  - 1. Non-Payment: If warrantor refuses to issue warranty, or attempts to revoke warranty due to lack of payment by any party other than the Owner, the Contractor shall resolve the payment conflict, and cause the warranty to be issued or reinstated.
  - 2. Incomplete or incorrect Installation: If warrantor refuses to issue warranty, or attempts to revoke warranty due to improper installation or other deficiency, the Contractor shall correct the deficiency and cause the warranty to be issued or reinstated.
- H. Transferable Warranties: All warranties shall permit Owner to transfer or assign warranties to future owners or other assignors at no additional cost to the Owner for the full warranty period.

#### 1.13 CUTTING AND PATCHING

- A. Limitations: Do not cut and patch any work in a manner that would result in a failure of the work to perform as intended, decreased energy performance, increased maintenance, decreased operational life, or decreased safety.
  - 1. Structural Work: Do not cut structural work or bearing walls without written approval from Architect. Where cutting and patching of structural work is necessary and approved by Architect, perform work in a manner which will not diminish structural capacity nor increase deflection of member. Provide temporary shoring and bracing as necessary. Ensure the safety of people and property at all times.
- B. Cutting and Patching Materials: Use materials identical to materials to be cut and patched. If identical materials are not available or cannot be used, use materials that match existing materials to the greatest extent possible. Provide finished work that will result in equal to or better than existing performance characteristics.
- C. Inspection: Before cutting and patching, examine surfaces and conditions under which work is to be performed and correct unsafe and unsatisfactory conditions prior to proceeding.

- D. Protection: Protect adjacent work from damage. Protect the work from adverse conditions.
- E. Cutting: Cut work using methods least likely to damage adjoining work. Use tools designed for sawing or grinding, not hammering or chopping. Use saws or drills to ensure neat, accurately formed holes to sizes required with minimum disturbance to adjacent work. Temporarily cover openings; maintain weathertightness and safety.
  - 1. Utilities: Locate utilities before cutting. Provide temporary utilities as needed. Cap, valve, or plug and seal ends of abandoned utilities to prevent entrance of moisture or other foreign matter.
- F. Patching: Patch with seams and joints which are durable and not visible. Comply with specified tolerances for similar new work; create true even planes with uniform continuous appearance. Restore finishes of patched areas and, if necessary, extend finish restoration onto adjoining unpatched area to eliminate evidence of patching and refinishing. Repaint entire assemblies, not just patched area. Remove and replace work which has been cut and patched in a visually unsatisfactory manner as determined by the Architect.
- G. Qualifications: Retain experienced and specialized firms, original installers if possible, to perform cutting and patching. Workmen shall be skilled in type of cutting and patching required.

#### 1.14 TEMPORARY FACILITIES AND UTILITIES

- A. Scope of Temporary Work: This article is not intended to limit the scope of temporary work required under the Contract. Provide all temporary facilities and utilities needed.
- B. Permits and Fees: Obtain and pay for all permits, fees and charges related to temporary work.
- C. Codes and Authorities Having Jurisdiction for Temporary Facilities and Utilities: Comply with all requirements of authorities having jurisdiction, codes, utility companies, OSHA, and industry standards including, but not limited to the following:
  - 1. NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
  - 2. ANSI-A10 Series, Safety Requirements for Construction and Demolition.
  - 3. NECA National Joint Guideline NJG-6, Temporary Job Utilities and Services.
  - 4. Electrical Service: NEMA, NECA, and UL.
- D. Field Offices: Provide Contractor's field offices as needed. Keep current copies of all Contract Documents and project paperwork neatly on file at jobsite. Permit Architect's unrestricted use of Contractor's field office facilities including copiers, telephones, plan tables, and other equipment. Furnish, maintain, and pay for light, power, phone, fax, and other field office services.
- E. Shops and Sheds: At Contractor's option, provide shops and sheds for Contractor's use as needed. Locate shops and sheds where acceptable to Owner and authorities having jurisdiction. Prior to completion of construction, temporary storage facilities and surplus stored materials shall be removed from the site.
- F. Temporary Heat: Provide temporary heat as needed to protect the work and create a suitable work environment. Provide temporary heat to protect the exterior construction against injury or damage resulting from cold temperature and dampness, to heat materials, and to maintain the minimum temperatures specified herein and in individual specification sections. Protect building

from soot, smoke and fire damage. Do not use heaters which would interfere with curing of mortar and grout or damage any materials.

1. Heaters for temporary heat shall be approved temporary steam generators or forced warm air heaters located outside the building or vented to the outside, or other safety type UL approved heating devices acceptable to the Architect.
  2. Oil burning salamander type heaters will not be permitted. Non-vented, open flame heaters will not be permitted inside the building once the building is closed-in.
  3. Propane type-heaters will not be permitted within the area of the building or near stockpiles of combustible materials.
  4. Permanent building equipment shall not be used without written permission from the Owner. If the equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, and similar items. Prior to turnover to Owner, the equipment shall be in a clean, like new condition. The guarantee period shall not start until the equipment is turned over to the Owner for their use. Do not invalidate existing warranty by any action or failure to act. Clean and change air filters frequently to prevent construction dust and debris from contaminating system.
- G. Pumping and Drainage: Protect excavations, trenches, buildings and materials from rain water, ground water, backup or leakage of sewers, drains and other piping, and from water of any other origin. Promptly remove any accumulation of water. Provide and operate all pumps, piping and other equipment necessary for pumping, drainage and protection from water.
- H. Equipment and Tools: Provide all equipment including, but not limited to, hoists, lifts, scaffolding, machines, tools and the like, as needed for execution of the work. Provide safe access to all parts of the work.
- I. Temporary Enclosures: Provide temporary enclosures to maintain proper temperatures and to prevent weather damage. Always maintain legal means of egress.
- J. Snow and Ice: Remove all snow and ice which interferes with work or safety.
- K. Streets, Walks and Grounds: Maintain public and private roads and walks clear of debris caused by construction operations. Repair all damage caused to streets, drives, curbs, sidewalks, fences, poles and similar items where disturbed or damaged by building construction and leave them in as good condition after completion of the work as before operations started.
- L. Protection: Protect nearby property and the public from construction activities. Provide and maintain barricades, warning signs and lights, railings, walkways and similar items. Immediately repair damaged property to its condition before being damaged.
- M. Public Services: Provide temporary public services such as, street lighting, night lighting, sidewalks, covered passages, signs, signals and the like, as requested by authorities having jurisdiction.
- N. Construction Fencing: Provide construction fencing and barriers as applicable to the project and as required by code to protect personnel, the public, and to control access.
- O. Security: Secure site against unauthorized entry at all times. Provide secure, locked temporary enclosures. Protect the work at all times. Provide watchman service, if necessary, to protect the work.
- P. Signs: Erect project identification signs in compliance with details to be provided by Architect. Signs shall be minimum 4' x 8' exterior grade plywood and shall contain the names of the

project, Owner, Architect, major Consultants, Contractor, and major financing institution. Except for safety and warning signs, no other signs are permitted. Location as acceptable to the Architect.

- Q. Fire Prevention: Take every precaution to prevent fire. Provide and maintain in good operating condition suitable and adequate fire protection equipment and services, and comply with recommendations regarding fire protection made by the representative of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal. The area within the site limits shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site.
- R. Egress: Maintain safe and legal means of egress at all times. At all times, provide at least two separate means of egress.
- S. Mold Control and Remediation During Construction: The Contractor shall protect construction materials and building systems from moisture damage and from conditions which promote mold growth during and after construction. The Contractor shall be responsible for mold remediation and replacement of materials which cannot be successfully remediated in accordance with the following requirements:
  - 1. Materials which become wet prior to installation shall be cleaned, treated and dried in accordance with EPA Guidelines.
  - 2. Materials which exhibit mold growth prior to installation shall not be installed and shall be removed from the site.
  - 3. Materials which exhibit mold growth after installation shall be remediated in accordance with EPA Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water. The Contractor shall engage and pay for a qualified industrial hygienist acceptable to the Owner to determine the cause of the mold growth, and to certify in writing that materials have been successfully remediated. In the event that the industrial hygienist recommends methods of remediation in addition to those in the Guidelines, the Contractor shall also be responsible for the additional remediation. Materials which can not be successfully remediated shall be removed and replaced with new materials at no additional expense to the Owner.
  - 4. Prior to the start of construction, the Contractor shall submit the name of the person in the Contractor's organization responsible for ensuring compliance with these requirements for mold control and remediation.
- T. Existing Mold-Contaminated Materials: In the event that mold-contaminated materials are encountered during remodeling operations, the Contractor shall stop work in that area and notify the Owner and Architect in writing. The Owner will engage and pay for an industrial hygienist to evaluate the situation to advise the Contractor on the proper course of action.

#### 1.15 PRODUCTS AND SUBSTITUTIONS

- A. Specified Products: In all cases in which a manufacturer's name, trade name or other proprietary designation is used in connection with materials or articles to be furnished under this Contract, whether or not the phrase "or equal" is used after such name, the Contractor shall provide the product of the named manufacturers without substitution, unless a written request for a substitution has been submitted by the Contractor and approved in writing by the Architect.
- B. Deviations from Detailed Requirements: If the Contractor proposes to use material which, while suitable for the intended use, deviates in any way from the detailed requirements of the Contract Documents, the Contractor shall inform the Architect in writing of the nature of such deviations at the time the materials is submitted for approval, and shall request written approval of the deviation from the requirements of the Contract Documents.

- C. Approval of Substitutions: In requesting approval of deviations or substitutions, the Contractor shall provide evidence, including, but not limited to manufacturer's data, leading to a reasonable certainty that the proposed substitution or deviation will provide a quality of result at least equal to that attainable if the detailed requirements of the Contract Documents were strictly followed. If, in the opinion of the Architect, the evidence presented by the Contractor does not provide a sufficient basis for such reasonable certainty, the Architect may reject such substitution or deviation without further investigation.
- D. Intent of Contract Documents: The Contract Documents are intended to produce a building of consistent character and quality of design. All components of the building including visible items of mechanical and electrical equipment have been selected to have a coordinated design in relation to the overall appearance of the building. The Architect shall judge the design and appearance of proposed substitutes on the basis of the suitability in relation to the overall design of the Project, as well as for their intrinsic merits. The Architect will not approve as equal to materials specified proposed substitutes which in the Architect's opinion, would be out of character, obtrusive, or otherwise inconsistent with the character or quality of design of the Project. In order to permit coordinated design of color and finishes the Contractor shall furnish the substituted material in any color, finish texture, or pattern which would have been available from the manufacturer originally specified, at no additional cost to the Owner.
- E. Additional Costs or Impact: Any additional cost, or any loss or damage arising from the substitution of any material or any method for those originally specified shall be borne by the contractor, notwithstanding approval or acceptance of such substitution by the Owner or the Architect, unless such substitution was made at the written request or direction of the Owner and the Architect. Any decrease in the cost of the substitution shall be returned to the Owner.
- F. Manufacturers: To the greatest degree possible, provide primary materials and products from one manufacturer for each type or kind. Provide secondary materials as recommended by manufacturers of primary materials.
- G. Substitution Requests: Refer to Section 016200 - SUBSTITUTION REQUEST FORM. Submit 3 copies. Identify product to be replaced by substitute by reference to specification sections and drawing numbers. Provide Contractor's certification and evidence to prove compliance with Contract Document requirements as acceptable to Architect.
- H. Substitution Conditions: Substitution requests will be returned without action unless one of the following conditions is satisfied. The Contractor shall state which of the following conditions applies to the requested substitution:
  - 1. Request is due to an "or equal" clause.
  - 2. Specified material or product cannot be coordinated with other work.
  - 3. Specified material or product is not acceptable to authorities having jurisdiction.
  - 4. Substantial advantage is offered Owner in terms of cost, time, or other valuable consideration.
  - 5. Specified material or product is not available.
- I. Invalid Substitutions: Contractor's submittal and Architect's acceptance of shop drawings, samples, product data or other submittal is not a valid request for, nor an approval of a substitution unless the Contractor presents the information when first submitted as a Request for Substitution.
- J. Compatibility of Materials Used in the Work:
  - 1. Ensure complete compatibility between materials.

2. Compatibility shall include adhesion, erosion, solubility, differential thermal response, and galvanic action.
3. Provide evidence of compatibility.
4. Provide custom testing where evidence is not available.
5. Where materials are not compatible, provide necessary isolation or transition materials and provide details of same.
6. Correct defects resulting from incompatibility including de-construction and re-construction of assemblies – whether materials are part of a submittal and substitution process or not.
7. Proposed substitutions may be rejected where compatibility information is not provided; or where compatibility is not adequately addressed, according to the Architect's judgment; or where incompatible materials would negatively impact the project's success.

#### 1.16 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's Instructions: Strictly comply with manufacturer's instructions and recommendations and prevent damage, deterioration and loss, including theft. Minimize long-term storage at the site. Maintain environmental conditions, temperature, ventilation, and humidity within range permitted by manufacturers of materials and products used.

#### 1.17 OWNER-FURNISHED CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner will furnish products indicated. The Contractor's 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: As directed by the Architect.

#### 1.18 LABELS

- A. Labels, Trademarks, & Tradenames: Locate required labels on inconspicuous surfaces. Do not provide labels, nameplates, or trademarks which are not required. Provide permanent data

plate on each item of equipment stating manufacturer, model, serial number, capacity, ratings and all other essential data.

#### 1.19 RECORD DOCUMENTS

- A. Definition of As-Constructed Record Drawings: (commonly called “as-builts”) are the record of the Project as constructed based on information the Contractor provides to the Owner under the contract for construction. Because the As-constructed Record Drawings will be based on the Contractor’s mark-ups, the Architect is not responsible for the accuracy or completeness of the As-constructed Record Drawings.
- B. Definition of As-Designed Record Drawings: The record of everything the Architect designed for the Project, and including the original Construction Documents plus all addenda, Architect’s Supplemental Instructions, Change Orders, Construction Change Directives and minor changes in the work.
- C. General: Keep as-constructed record documents neatly and accurately. Record information as the work progresses and deliver to Architect at time of final acceptance. Include in record documents all field changes made, all relevant dimensions, and all relevant details of the work. Keep record documents up to date with all Architect’s Supplemental Instructions, Change Orders, Construction Change Directives and minor changes in the work clearly indicated.
- D. Drawings: Keep four separate sets of blackline prints at the site, one set each for mechanical, electrical, plumbing, and architectural/structural disciplines. Neatly and accurately note all deviations from the Contract Documents and the exact actual location of the work as installed. Marked-up and colored prints will be used as a guide to determine the progress of the work installed. Requisitions for payment will not be approved until the record documents are accurate and up-to-date.
  - 1. Work Outside Building: Record data outside of building to an accuracy of plus or minus 1 inch and determine and record the invert elevation of all drain lines.
  - 2. At completion of the work, submit one complete set of marked-up as-built prints for review. After acceptance, these marked-up as-built prints shall be used in the preparation of the as-built drawings.
  - 3. Architect shall furnish Contractor with AutoCAD or BIM Design Intent Model or both files for originals of the Contract Drawings. The Contractor shall make modifications to these files as shown on the marked-up prints. Remove superseded data to show the completed installation.
  - 4. The Contractor shall deliver the completed AutoCAD or BIM Design Intent Model or both as-constructed record drawings, in the same version as Contract Drawings, properly titled and dated to the Architect. Indicate preparer of as-built drawings. These as-built drawings shall become the property of the Owner.
- E. Specifications: Maintain one clean copy of complete specifications including addenda, modifications, and bulletins with changes, substitutions, and selected options clearly noted. Circle or otherwise clearly indicate which manufacturer and products are actually used.
- F. Operating and Maintenance Manuals: Manuals shall be submitted which contain the following:
  - 1. Description of the system provided.
  - 2. Handling, storage, and installation instructions.
  - 3. Detailed description of the function of each principal component of the systems or equipment.
  - 4. Operating procedures, including prestartup, startup, normal operation, emergency shutdown, normal shutdown and troubleshooting.

5. Maintenance procedures including lubrication requirements, intervals between lubrication, preventative and repair procedures, and complete spare parts list with cross reference to original equipment manufacturer's part numbers.
  6. Control and alarm features including schematic of control systems, control loop electric ladder diagrams, controller operating set points, settings for alarms and shutdown systems, pump curves and fan curves.
  7. Safety and environmental considerations.
- G. Copies of Operating and Maintenance Manuals: Three copies of the manuals shall be provided within sufficient time to allow for training of Owner's personnel. Submit one copy of the manuals to the Architect for review no later than 90 calendar days prior to substantial completion, or building turn over, whichever comes first. Submit the remaining five copies within 15 days after first review set is returned to contractor. Progress payment may be withheld if this requirement is not met.
- H. Additional Requirements for Operating and Maintenance Manuals: The requirements for manuals applies to each packaged and field-fabricated operating system. The manuals shall be provided in three-ring side binders with durable plastic covers. The manuals shall contain a detailed table of contents and have tab dividers for major sections and special equipment.
- I. Framed Data: Provide charts and lists of all valves, circuits, switches, controls and equipment. Install on walls under glass at locations directed by Architect.

#### 1.20 PROJECT CLOSE OUT

- A. Complete the following prior to Substantial Completion:
1. Provide Contractor's Punch List of incomplete items stating reason for incompleteness and value of incompleteness.
  2. Advise Owner of insurance change over requirements.
  3. Submit all warranties, maintenance contracts, final certificates and similar documents.
  4. Obtain Certificate of Occupancy and similar releases which permit the Owner's full and unrestricted use of the areas claimed "Substantially Complete".
  5. Submit record documents.
  6. Deliver maintenance stocks of materials where specified.
  7. Make final change over of lock cylinders or cores and advise Owner of change of security responsibility.
  8. Complete startup of all systems and instruct Owner's personnel in proper operation and routine maintenance of systems and equipment.
  9. Complete clean up and restoration of damaged finishes.
  10. Remove all temporary facilities and utilities that are no longer needed.
  11. Request Architect's inspection for Substantial Completion.
- B. Architect will either issue a Certificate of Substantial Completion or notify Contractor of work which must be performed prior to issue of certificate.
- C. Complete the following prior to Final Acceptance and payment:
1. Obtain Certificate of Substantial Completion.
  2. Submit final application for payment, showing final accounting of changes in the work.
  3. Provide final releases and lien waivers not previously submitted.
  4. Submit certified copy of final punch list stating that Contractor has completed or corrected each item.
  5. Submit final meter readings, record of stored fuel and similar information.
  6. Submit Consent of Surety for final payment.

7. Submit evidence of Contractor's continuing insurance coverage (if required by Contract Documents).

1.21 FINAL CLEANING AND REPAIR

- A. Clean Up: Immediately prior to the Architect's inspection for Substantial Completion, the Contractor shall completely clean the premises and clean and prepare the completed work in order for it to be used for its intended purpose in accordance with the Contract Documents. Such work shall include, but not be limited to the following:
  1. Concrete and ceramic surfaces shall be cleaned and washed.
  2. Resilient coverings shall be cleaned, waxed and buffed as applicable.
  3. Woodwork shall be dusted and cleaned.
  4. Sash, fixtures and equipment shall be thoroughly cleaned.
  5. Stains, spots, dust, marks and smears shall be removed from all surfaces.
  6. Hardware and metal surfaces shall be cleaned and polished.
  7. Glass and plastic surfaces shall be thoroughly cleaned by professional window cleaners.
  8. Damaged, broken or scratched glass or plastic shall be replaced by the Contractor at the Contractor's expense.
  9. Vacuum carpeted and soft surfaces with high efficiency particulate arrestor (HEPA) vacuum.
  10. Use low-emitting, environmentally friendly cleaning agents and procedures. Do not use ammonia-, chlorine bleach-, or solvent-based cleaners, unless authorized in writing by Architect.
- B. Repairs: Repair and touch-up all damaged and deteriorated products and surfaces.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION [Not Used]

END OF SECTION

## SECTION 014330

### MOCKUPS

#### PART 1 - GENERAL

##### 1.1 GENERAL PROVISIONS

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

##### 1.2 SUMMARY

- A. General: Provide and coordinate mock-up assemblies at Project site for Architect's review and acceptance, in accordance with requirements of the Contract Documents. Refer to individual Specification Sections for mock-up requirements. Generally, without limitation, mock-ups on site include the following:
  - 1. Mock-ups of individual pieces of the work, as specified within individual Specification Section.
  - 2. Field Mock-Up of exterior wall components. Refer to the Drawings for extent of mock-up.
- B. It shall be the responsibility of the Contractor to coordinate the work of the related Specification Sections so that each mock-up meets the specified requirements.
- C. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Individual Specification Sections for Submittal Samples.

##### 1.3 DEFINITIONS

- A. Freestanding Mock-Ups: Full-size, physical assemblies that are constructed on-site in a protected location.
  - 1. Freestanding mock-ups are not part of the final construction. Freestanding mock-ups will be used to verify selections made under sample submittals, to demonstrate aesthetic effects, qualities of materials and execution, and to review construction, coordination, testing, and operation.
  - 2. Approved freestanding mock-ups establish the standard by which the Work will be judged.
  - 3. Approved freestanding mock-ups remain on site during the balance of construction and are demolished and removed from site at completion of the Work they represent.
- B. In-Place Mock-Ups: Full-size, physical assemblies that are constructed in-place and remain part of final construction.
  - 1. In-place mock-ups will be used to verify selections made under sample submittals, to demonstrate aesthetic effects, qualities of materials and execution, and to review construction, coordination, testing, or operation.
  - 2. Approved in-place mock-ups establish the standard by which the Work will be judged.

3. Approved mock-ups remain part of the completed Work.

#### 1.4 SUBMITTALS

- A. Schedule: Construction Manager shall submit a schedule of mock-up construction, including dates for mock-up review by the Architect.
  1. Mock-up schedule shall be reviewed at each progress meeting, revised and resubmitted as required.
  2. Schedule shall allow sufficient time for mock-ups which are not accepted to be reconstructed and reviewed until accepted by the Architect.
- B. Shop Drawings of Mock-Ups: Provide large scale shop drawings for fabrication, installation and erection of all parts of each mock-up. Provide plans, elevations, and details of anchorage, connections and accessory items.
- C. Photographs of Mock-Ups: Submit photographs of mock-ups after completion of installation and acceptance of each mock-up.
- D. Submittal Samples: Refer to individual Specification Sections for submittal requirements of mock-up components and coordinate accordingly.

#### 1.5 QUALITY ASSURANCE

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

### PART 2 - PRODUCTS

#### 2.1 MATERIALS AND PRODUCTS

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

### PART 3 - EXECUTION

#### 3.1 GENERAL

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

#### 3.2 FIELD MOCK-UP OF EXTERIOR WALL

- A. Provide a field mock-up of the exterior wall at location and in configuration indicated on Drawings. The exterior wall mock-up shall include the veneer systems and backup, one window and all related flashings and sealants, etc. Obtain Architect's acceptance of visual qualities prior to commencing work that individual mock-up is intended to represent. Protect and maintain approved mock-ups throughout the work of the Contract. Locate mock-ups at the Project site as directed by the Architect.
  1. Refer to Drawings for extent of the field mock-up.

2. Provide modifications to mock-up as required until Architect's approval has been received.

### 3.3 INDIVIDUAL MOCK-UPS

- A. Provide individual mock-ups of types and sizes required by individual Specification Sections to evaluate and set the standard of quality for that work. Obtain Architect's acceptance of visual qualities prior to commencing work that individual mock-up is intended to represent. Protect and maintain approved mock-ups throughout the work of the Contract. Locate mock-ups at the Project site as directed by the Architect.
  1. Provide as many mock-ups as required until Architect's approval has been received.
  2. When indicated in individual Specification Sections, approved mock-ups may be incorporated into the finish work.

### 3.4 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as non-visible as possible.
- B. Protect construction exposed by or for quality-control service activities.

### 3.5 REMOVAL AND DISPOSAL

- A. Demolish and remove mock-ups from site at the completion of the Project. Legally dispose of demolished mock-up materials. Comply with requirements of Section 017400 – CONSTRUCTION WASTE MANAGEMENT.

END OF SECTION

SECTION 016200

SUBSTITUTION REQUEST FORM

No substitutions will be considered without this completed substitution request form and supporting documentation. Substitutions made without completion of this form will be considered defective work as stated in AIA A201.

Date: \_\_\_\_\_

Number: \_\_\_\_\_

Re: Request for Substitution

The Contractor proposes the following substitution in accordance with the requirements of the Contract Documents:

Scope of Substitution \_\_\_\_\_  
\_\_\_\_\_

Specification Reference \_\_\_\_\_  
\_\_\_\_\_

Drawing Reference \_\_\_\_\_  
\_\_\_\_\_

Reason for Proposed Substitution \_\_\_\_\_  
\_\_\_\_\_

Benefit to Owner \_\_\_\_\_  
\_\_\_\_\_

Impact on Project Cost \_\_\_\_\_  
\_\_\_\_\_

Impact on Project Schedule \_\_\_\_\_  
\_\_\_\_\_

Impact on Guarantees and Warranties \_\_\_\_\_  
\_\_\_\_\_

Coordination and Compatibility Required with Adjacent Materials and System \_\_\_\_\_  
\_\_\_\_\_

List Deviations  
From Specified  
Requirements

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Attachments: Attach supporting documentation sufficient for Architect to evaluate substitution.  
Substitution Request Forms submitted without adequate documentation will be returned without review.

Attachments

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Response Date: List date by which response by Architect is requested to maintain project schedule and  
allow sufficient time for inclusion of proposed substitution.

Response Date

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Submitted By

---

Firm and Address

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Signature below signifies acceptance of responsibility for accuracy and completeness of information  
included in this Substitution Request Form.

Authorized Signature

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ARCHITECT'S RESPONSE

Notations listed below shall have same meaning as on Architect's approval stamp. Clarifications to or changes in project schedule or time shall be processed using standard project forms.

- Architect's Response            \_\_\_\_\_ Approved
- \_\_\_\_\_ Approved as Corrected
- \_\_\_\_\_ Revise and Resubmit
- \_\_\_\_\_ Rejected
- \_\_\_\_\_ Returned Without Review

Remarks

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Date

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Signed

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END OF FORM

SECTION 017400

CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 SUMMARY

- A. This Section includes requirements for the Contractor's implementation of waste management controls and systems for the duration of the Work.
- B. Develop a waste management plan, quantifying material diversion by either weight or volume to recycle and/or salvage non-hazardous construction and demolition debris.

1.3 INTENT

- A. The Owner and Architect have established that this Project shall generate the least amount of waste practical and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
- B. With regard to these goals the Contractor shall develop, for the Architect's review, a Construction Waste Management Plan (CWMP) for this Project.
- C. Each Subcontractor shall be responsible for segregating his own waste into different dumpsters as directed by the Contractor.
- D. Contractor shall be responsible for ensuring that debris will be disposed of at appropriately designated licensed solid waste disposal facilities, as defined by MGL Chapter 111, Section 150A.

1.4 SUBMITTALS

- A. Waste Management Plan (WMP): Submit within 21 calendar days after receipt of Notice to Proceed, in a format acceptable to the Owner.
  - 1. Analysis of the proposed jobsite waste to be generated, including types and rough quantities.
  - 2. Landfill Options: The name of the landfills where trash and building debris will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfills.
  - 3. Landfill Certification: Contractor's statement of verification that landfills proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.
  - 4. Alternatives to Landfilling: A list of each material proposed to be salvaged or recycled during the course of the Project. Include the following and any additional items proposed:
    - a. Cardboard and paper products.
    - b. Clean dimensional wood.

- c. Beverage containers.
  - d. Concrete.
  - e. Slurry wall materials.
  - f. Bricks and masonry.
  - g. Asphalt.
  - h. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
  - i. Mechanical and electrical equipment.
  - j. Building components which can be removed relatively intact from existing construction.
  - k. Packaging materials, including cardboard, boxes, plastic sheet and film, polystyrene packaging, wood crates, plastic pails.
  - l. Glass.
  - m. Scraps from new gypsum wall board.
  - n. Carpet and pad.
  - o. Acoustical ceiling panels.
  - p. Plastics.
5. Meetings: A description of the regular meetings to be held to address waste management.
  6. Materials Handling Procedures: A description of the means by which any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
  7. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.
- B. Waste Management Progress Reports: Concurrent with each Application for Payment, submit a written Waste Management Progress Report in the same format as required for Final Report.
- C. Waste Management Final Report: Prior to Substantial Completion, submit a written Waste Management Final Report summarizing the types and quantities of materials recycled and disposed of under the Waste Management Plan. Include the name and location of disposal facilities.
1. Material category.
  2. Generation point of waste.
  3. Total quantity of waste, by weight.
- D. Other Submittals:
1. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
  2. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
  3. 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, and/or receipts.
  4. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, and/or receipts.
  5. 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.

## 1.5 CONTRACTORS

- A. Contractor may subcontract work of this Section to a sub-contractor specializing in recycling and salvaging of construction waste.
- B. Gypsum Wallboard Recycling: New, paper-faced gypsum wallboard scrap (cuts from construction - not demolition waste) generated at project shall be recycled. Keep scrap dry. Contact Cambridge Gypsum Recycling at 508-868-9664, to coordinate recycling efforts.
- C. Acoustical Ceiling Panel Recycling: Demolition and construction waste pulpable mineral fiber ceiling panels may be recycled by Armstrong World Industries and US Gypsum. Contact Armstrong at 1-877-ARMSTRONG (1-877-276-7876) or [www.armstrong.com](http://www.armstrong.com) or contact USG at 1-800-USG-4YOU or [www.usg.com](http://www.usg.com), to coordinate recycling efforts, apply for product approvals, and receive reclamation procedure requirements.
- D. Carpet Recycling: Demolition and construction waste carpet and carpet padding may be recycled by Carpet America Recovery Effort (CARE). Visit [www.carpetrecovery.org](http://www.carpetrecovery.org) to locate carpet reclaimers in local project area and reclamation procedure requirements.

## PART 2 - PRODUCTS [Not Used]

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement Waste Management Plan as approved by the Architect. Provide containers, storage, signage, transportation, and other items as required to implement WMP for the entire duration of the Contract.

### 3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.
- B. Distribution: The Contractor shall distribute copies of the Waste 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 separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.
- D. Separation Facilities: The Contractor shall lay out and label a specific area to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials. Location shall be acceptable to the Architect.
- E. Hazardous Wastes: Any unforeseen hazardous wastes shall be separated, stored, and disposed of according to local regulations and as directed by the Owner.

END OF SECTION

SECTION 018120

CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. 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.
  - 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 011000 - GENERAL REQUIREMENTS; Submittal requirements.
  - 2. Section 011000 - GENERAL REQUIREMENTS; Construction facilities and controls.
  - 3. Section 017400 - CONSTRUCTION WASTE MANAGEMENT.
  - 4. Division 23 - HVAC.
  - 5. 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.

#### 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 as indicated in Section 011000, GENERAL REQUIREMENTS.

END OF SECTION

SECTION 024100

DEMOLITION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

A. Work Included:

1. Demolition and removal of selected portions of buildings and structures and as required for new work. Refer to the Drawings for additional requirements.
2. Demolition and removal of selected site elements and as required for new work. Refer to the Drawings for additional requirements.
3. Salvage of existing items to be reused or turned over to the facility.
4. Removal and legal disposal of demolished materials off site. Except those items specifically designated to be relocated, reused, or turned over to the facility, all existing removed materials, items, trash and debris shall become property of the Contractor and shall be completely removed from the site and legally disposed of at their expense. Salvage value belongs to the Contractor. On-site sale of materials is not permitted.
5. Maintenance, watering and care of trees designated to remain by a certified arborist during the construction period.
6. Demolition and removal work shall properly prepare for alteration work and new construction to be provided under the Contract.
7. Scheduling and sequencing operations without interruption to utilities serving occupied areas. If interruption is required, obtain written permission from the utility company and the Owner.

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

1. Section 011000 - GENERAL REQUIREMENTS for temporary facilities and controls, for maintenance of access, for cleaning during construction, and for dust and noise control.
2. Section 017400 - CONSTRUCTION WASTE MANAGEMENT for waste management and recycling.
3. Section 018120 - CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT for indoor air quality control procedures.
4. Division 21 - FIRE PROTECTION:
  - a. Disconnecting, capping and otherwise making inactive existing fire protection services in areas where demolition and removal work is required.
  - b. Disconnect and reinstallation of fire protection equipment temporarily interrupted during construction.
5. Division 22 - PLUMBING:

- a. Disconnecting, capping and otherwise making inactive existing plumbing services in areas where demolition and removal work is required.
  - b. Disconnection and reinstallation of plumbing equipment temporarily interrupted during construction.
6. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING:
- a. Disconnecting, capping and otherwise making inactive existing HVAC services in areas where demolition and removal work is required.
  - b. Disconnect and reinstallation of HVAC equipment temporarily interrupted during construction.
7. Division 26 - ELECTRICAL WORK:
- a. Disconnecting, capping and otherwise making inactive existing electrical services in areas where demolition and removal work is required.
  - b. Disconnect and reinstallation of electrical equipment temporarily interrupted during construction.

### 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 035412

GYPSUM CEMENT UNDERLAYMENT

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 cement floor topping used as finish floor underlayment.
  - 2. Sub-floor joint and crack preparation.
  - 3. Primers.
  - 4. Sealer/overspray protection. Work of this Section includes sealing bottom of wallboard with asphaltic paper or tape to prevent moisture damage, and pour stops and sealing to prevent leakage to other areas.
- 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 concrete slab construction.
  - 2. Section 061000 - ROUGH CARPENTRY for construction panel subflooring.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include design mixes with proposed strengths. Include information necessary to establish conformance with specified performance criteria; instructions for installing, curing and repairing of underlayment and for installation of floor finishes.
- B. Field quality-control test reports.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for floor toppings.
  - 1. Include UL Assembly test reports indicating compliance with indications on drawings and UL #L546.
- D. Minutes of preinstallation conference.
- E. Certificates: Provide or certify compliance with the following:
  - 1. Specifications.
  - 2. UL No. L546.

3. From authorities having jurisdiction indicating approval of underlayment materials in the required fire rated assemblies.

#### 1.4 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 underlayment 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.
- D. The underlayment installer shall be an authorized applicator approved by the product manufacturer with not less than 5 years experience on comparable projects.
- E. Use only mixing and pumping equipment approved by the manufacturer.
- F. Compatibility: Coordinate with flooring manufacturers to verify compatibility between underlayment and flooring.

#### 1.5 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.

#### 1.6 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 underlayment performance.
  1. Place underlayment only when ambient temperature and temperature of base substrates are between 50 and 86 deg F, at least 24 hours before and 72 hours after installation.
- B. Close areas to traffic during topping application and, after application, for time period recommended in writing by manufacturer.

#### 1.7 WARRANTY

- A. Special Manufacturer's Warranty: Provide manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective work within specified warranty period.

1. Warranty Period: As standard with manufacturer unless indicated otherwise.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Underlayment: "Gyp-Crete 2000 / 3.2K" gypsum concrete equal to Maxxon Commercial Mix: or equal a mill mixture of calcined gypsum and aggregate; shall comply with ASTM C317 (latest edition), Class B, Standard Specification for Gypsum Concrete, except compressive strengths shall be as specified and no wood products, chips or the like may be incorporated into the mix.
  1. Compressive Strength: Provide the following minimum strength range per ASTM F2419 when tested in accordance with ASTM C472: Minimum 3000 psi.
  2. Density: Minimum dry density in pounds per cubic foot - 100 for regular strength and 115 for high strength.
  3. Fire Hazard Classification: Flame Spread - 0, Fuel Contributed - 0, Smoke Density - 0, when tested in accordance with ASTM D:E286.
  4. VOC: Greenguard Children and Schools Certified
  5. Minimum STC - Sound Transmission Class: 50 STC.
  6. Minimum IIC - Impact Insulation Class: 50 IIC.
- B. Aggregate: 1/8 inch to 1/16 inch or less washed mason, mortar, or plaster sand complying with ASTM:C 144 and with Maxxon sand specification no. 101. Vary aggregate size depending upon applications. For feather edge applications, use smaller aggregate meeting specified requirements.
- C. Water: potable, free from impurities.
- D. Subfloor Primer: Bonding agent of type recommended by the manufacturer to provide the required adhesion between underlayment and substrate.
- E. Crack and Joint Fillers: Materials recommended and approved of by underlayment manufacturer.
- F. Feather to Zero Products: Installed products shall match level and flatness required for finish floor installations. Refer to applicable sections, schedules and legends. Where typical cementitious application do not produce required flatness and level, provide appropriate "feather-to-zero" products of type recommended by manufacturer for application. In general use products manufactured by Silrpo or Ardex for these applications.

### 2.2 MIXING PROPORTIONS

- A. Mix gypsum concrete in accordance with manufacturer's recommendations for the type of placement employed and for the finish materials to be installed over the underlayment. Do not exceed amounts of water as determined by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of underlayment.

- B. Ensure building is enclosed with permanent roofs, doors, and fenestration. Do not begin installation of regular strength underlayment until gypsum wallboard has been installed.
- C. Examine all surfaces to receive underlayment prior to installation. Do not commence work in any area where conditions exist which would adversely affect the adhesion and strength of the underlayment until corrective work has been completed.
  - 1. Surfaces to receive underlayment shall be thoroughly clean, free of mud, oil, grease or other contaminants which may degrade final product.
  - 2. Surfaces to receive underlayment shall be dry and free of moisture.
  - 3. Test substrates with moisture meters or by other methods and report findings in writing.
  - 4. Verify that base concrete slabs comply with scratch finish requirements specified in Section 033000 - CAST-IN-PLACE CONCRETE. Test slabs 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. Fill non-moving cracks, voids and joints as recommended by the underlayment materials manufacturer and to prevent leakage.
- B. Control joints: Provide pour stops to prevent underlayment from being installed across through joints.
- C. Priming - General: Prime substrate according to manufacturer's instructions using approved product. Apply primer at rate and in number of coats recommended by manufacturer.
- D. 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. Insure uniform, continuous flow of gypsum concrete at point of delivery, without segregation and loss of material. Immediately spread and screed product to a smooth surface.
- C. Take necessary precautions to prevent splashing or spillage of materials onto adjoining surfaces.
- D. Except at authorized joints, place underlayment as continuously as possible until entire section is complete so that no slurry is placed against gypsum concrete that has obtained its initial set, except at authorized joints.

- E. Install control joints following manufacturer's recommendations in locations indicated on the Drawings.
- F. Place material in one layer 3/4 inch thick. Spread and screed to a smooth surface in one continuous operation to required tolerances of level and flatness.
  - 1. Coordinate installations at toilets.
- G. Allowable Tolerances:
  - 1. At unfinished floors and floors receiving carpet: finish surface shall be level to within L/360.
  - 2. At floors receiving hard floor finish such as thin set stone, wood flooring or ceramic tile and VCT or the like, underlayment shall be leveled to within a tolerance of 1/8" in any 10'-0", unless otherwise shown.
  - 3. Tolerances shall not be cumulative over runs longer than 20 feet, and in no case be sufficiently great to adversely affect proper installation of work.
  - 4. Comply with floor flatness indicated in documents or directed by Architect.
  - 5. Employ "feather-to-zero" products as required to meet required tolerances.
  - 6. Do not reduce floor thickness below that required for indicated fire ratings.
- H. Allow underlayment to cure properly. Block off traffic and protect floor underlayment from physical damage during curing.
- I. Test for dryness by taping 24 x 24 inch sections of plastic to concrete underlayment surface. After approximately 16 hours of curing, if no condensation occurs, test the floor with moisture meters and verify that the installation meets the requirements for dryness of the specified finish.

### 3.5 PROTECTING AND CURING

- A. General: Protect freshly placed underlayment from premature drying and excessive cold or hot temperatures.
- B. Evaporation Retarder: Apply evaporation retarder to 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 floor topping. Cure by according to 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 underlayment 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. Include a written report of the moisture readings and condensation tests given dates, results, attendance at test and devices used
  - 1. Perform tests only when ambient air and underlayment surfaces are between 50 and 86 degrees.
- B. Testing Services: Testing and inspecting of completed applications of 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 each mobilization. Samples shall be tested according to ASTM C 109 for compliance with compressive-strength requirements.
  - 2. Underlayment shall be tested for delamination by dragging a steel chain over the surface.
  - 3. Underlayment shall be tested for compliance with surface flatness and levelness tolerances.
- C. Remove and replace applications of 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.

### 3.9 PROTECTION

- A. Protection From Heavy Loads: During construction, place temporary wood planking over underlayment wherever it will be subject to heavy wheeled or concentrated loads.

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)

PROJECT IDENTIFICATION: Orleans Community Building

SUB-BID FOR SECTION: 040001 – MASONRY WORK

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: *To be inserted with final documents.*

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 040120 – MASONRY RESTORATION AND CLEANING
2. All Work of Section 044300 – STONE MASONRY

END OF SECTION

SECTION 040120

MASONRY RESTORATION AND CLEANING

(Part of Work of Section 040001 - MASONRY WORK, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Repairing clay and stone masonry, including replacing damaged units as indicated on Drawings.
  2. Repointing mortar joints, removing existing mortar and replacing with new color mortar.
  3. Provide for repair or replacement of clay and stone masonry broken or damaged during disassembly and reconstruction. Contractor shall be responsible for damage resulting from work of this Section.
  4. Provide shoring and bracing required to maintain stability of masonry during work of this Section. Coordinate with requirements of Section 011000 - GENERAL REQUIREMENTS.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 024100 - DEMOLITION for demolition, removal and salvage requirements, to the extent not specified in this Section.
  2. Section 044300 - STONE MASONRY for new stone masonry veneer.
  3. Section 076200 - SHEET METAL FLASHING AND TRIM for metal flashing installed in or on restored masonry.
  4. Section 079200 - JOINT SEALANTS for sealing joints in restored masonry.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.
- B. Samples for Verification: Before erecting mockup, submit samples of the following:
1. Each type of exposed masonry unit to be used for replacing existing units.
    - a. For each brick type, provide straps or panels containing at least four bricks.
    - b. For each stone type, provide straps or panels containing at least four stones.
  2. Each type of sand used for pointing mortar.

- a. For blended sands, provide samples of each component and blend.
    - b. Identify sources, both supplier and quarry, of each type of sand.
  3. Each type of pointing mortar in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.
    - a. Include with each sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.
  4. Each type of masonry patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each sample with manufacturer and stock number or other information necessary to order additional material.
- C. Restoration Program: For each phase of restoration process, provide detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of restoration work including protection of surrounding materials on building and Project site.
1. Include methods for keeping pointing mortar damp during curing period.
  2. If materials and methods other than those indicated are proposed for any phase of restoration work, provide a written description, including evidence of successful use on comparable projects, and a testing program to demonstrate their effectiveness for this Project.
- D. Cleaning Program: Describe cleaning process in detail, including materials, methods, and equipment to be used and protection of surrounding materials on building and Project site, and control of runoff during operations.
1. If materials and methods other than those indicated are proposed for cleaning work, provide a written description, including evidence of successful use on comparable projects, and a testing program to demonstrate their effectiveness for this Project.

#### 1.4 QUALITY ASSURANCE

- A. Chemical Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-trained representatives who are available for consultation and Project-site inspection and assistance at no additional cost.
- B. Source Limitations: Obtain each type of material for masonry restoration (face brick, stone, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.
- C. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to test the following. Provide test specimens and assemblies as indicated.
  1. Replacement Brick: For each proposed type of replacement brick, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).
  2. Existing Brick: For each type of existing brick indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove existing bricks from locations designated by Architect.

- D. Mockups: Prepare mockups of restoration and cleaning as follows to demonstrate aesthetic effects and qualities of materials and execution. Prepare mockups on existing walls under same weather conditions to be expected during remainder of the Work.
1. Repair an area approximately 36 inches high by 48 inches wide for each type of masonry material indicated to be rebuilt or replaced.
  2. Patch three small areas at least 1 inch in diameter for each type of masonry material indicated to be patched.
  3. Clean an area approximately 25 sq. ft. in area for each type of masonry and surface condition.
    - a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions unless cleaners and methods are known to have deleterious effect.
    - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
  4. Rake out joints in two separate areas approximately 36 inches high by 72 inches wide for each type of repointing required and repoint one of the two areas.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.
- B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- E. Store lime putty covered with water in sealed containers.
- F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

#### 1.6 PROJECT CONDITIONS

- A. Repoint mortar joints and repair masonry only when air temperature is between and 40 and 90 deg F and is predicted to remain so for at least 7 days after completion of work.
- B. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing:
  1. When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.

2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 7 days after repair and pointing.
  - C. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 90 deg F and above.
  - D. Patch masonry only when air and surface temperatures are between and 55 and 100 deg F and are predicted to remain above 55 deg F for at least 7 days after completion of work. On days when air temperature is predicted to go above 90 deg F, schedule patching work to coincide with time that surface being patched will be in shade or during cooler morning hours.
  - E. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least 7 days after completion of cleaning.
- 1.7 SEQUENCING AND SCHEDULING
- A. Order replacement materials at earliest possible date, to avoid delaying completion of the Work.
  - B. Order sand for repointing mortar immediately after approval of Samples or mockups. Take delivery of and store at Project site a sufficient quantity of sand to complete Project.
  - C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units to comply with Part 3 "Masonry Unit Patching and Repairs" Article. Patch holes in mortar joints to comply with Part 3 "Repointing Masonry" Article.

## PART 2 - PRODUCTS

### 2.1 MASONRY MATERIALS

- A. Face Brick and Accessories: Provide face brick and accessories, including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.
  1. Provide units with colors, surface texture, size, and shape to match existing brickwork and with physical properties not less than those determined from preconstruction testing of selected existing units.
    - a. For replacement brick at existing building provide brick to match existing as approved by Architect.
    - b. For existing brickwork that exhibits a range of colors, provide brick that matches that range rather than brick that matches an individual color within that range.
  2. Provide specially molded shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Building Brick: Provide building brick complying with ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.
  1. Grade SW where in contact with earth.
  2. Grade SW, MW, or NW for concealed backup.

- C. Stone: Reuse existing salvaged stones, where available, and as follows:
  - 1. Varieties, Cut and Finish: To match existing stones, as approved by Architect.
  - 2. For existing stone that exhibits a range of colors, finishes, sizes, or shapes, provide stone that matches that range rather than stone that matches an individual color, finish, size, or shape within that range.

## 2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II.
  - 1. Provide white cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Sand: ASTM C 144, unless otherwise indicated.
  - 1. Color: Provide natural sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
  - 2. For pointing mortar, provide sand with rounded edges.
  - 3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands, if necessary, to achieve suitable match.
- D. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.
  - 1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. SGS Mortar Colors: Solomon Grind-Chem Services, Inc.
    - b. True Tone Mortar Colors: Davis Colors, a Subsidiary of Rockwood Industries, Inc.
- E. Water: Potable, clean and free from injurious amount of oil, alkali, organic matter or other deleterious material.

## 2.3 MISCELLANEOUS MATERIALS

- A. Masonry Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching masonry, is vapor- and water permeable, exhibits low shrinkage, and develops high bond strength to all types of masonry.
  - 1. Formulate patching compound used for patching brick in colors and textures to match brick being patched. Provide number of colors needed to enable matching each brick.
  - 2. Available Products:
    - a. Cathedral Stone Products, Inc.; Jahn Restoration Mortar.
    - b. Edison Coatings, Inc.; Custom System 45.
    - c. Bonstone Materials Corp., Stone Repair.
- B. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

1. Available Products:
  - a. American Building Restoration Products, Inc.; LM 130 Acid Shield.
  - b. Diedrich Technologies Inc.; Diedrich Acid Guard.
  - c. Price Research, Ltd.; Price Mask.
  - d. ProSoCo; Sure Klean Strippable Masking.

C. Joint Sealant and Backer Rods: Refer to Section 079200 - JOINT SEALANTS.

## 2.4 MORTAR MIXES

A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

C. Colored Mortar: Produce mortar of color required by using selected ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.
2. Color: Match existing, or as otherwise directed by Architect.

D. Do not use admixtures of any kind in mortar, unless otherwise indicated.

E. Mortar Proportions: Mix mortar materials in the following proportions:

1. Pointing Mortar for Brick: 1 part portland cement, 2 parts lime, and 6 parts sand.
  - a. Add mortar pigments to produce mortar colors required.
2. Rebuilding (Setting) and Pointing Mortar, for Stone: Comply with ASTM C 270, Proportion Specification, Type N, unless otherwise indicated, with cementitious material limited to portland cement and lime.
  - a. Mix: 1 part portland cement, 2 parts lime, and 6-7 parts sand.
  - b. Add mortar pigments to produce mortar colors required.

## PART 3 - EXECUTION

### 3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.

1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.

B. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and projections to protect from mortar droppings.
2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
3. Immediately remove mortar in contact with exposed masonry and other surfaces.
4. Clean mortar splatters from scaffolding at end of each day.

3.2 UNUSED ANCHOR OR EMBEDDED STEEL REMOVAL

A. Remove embedded masonry anchors, brackets, wood nailers, and other extraneous items no longer in use unless identified as historically significant or indicated to remain.

1. Remove items carefully to avoid spalling or cracking masonry.
2. If item cannot be removed without damaging surrounding masonry, cut off item flush with surface and core drill surrounding masonry and item as close around item as practical.
3. Patch holes where items were removed unless directed to remove and replace units.

3.3 MASONRY UNIT PATCHING AND REPAIRS

A. Patch the following masonry units:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners.
4. Units with small areas of deep deterioration.

B. Remove and replace existing patches, unless otherwise indicated or approved by Architect.

C. Patching Bricks:

1. Remove loose material from brick surface. Remove additional material so patch will not have feathered edges and will be at least 1/4 inch thick, but not less than recommended by patching compound manufacturer.
2. Mask or remove surrounding mortar joints if patch will extend to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surface plane of surrounding brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.

D. Stone Repairs and Partial Stone Replacement (Dutchman Repair):

1. At locations indicated, remove rectangular portion of stone units. Carefully remove stone by making vertical and horizontal saw cuts at face of stone and demolishing corner portion of stone unit to depth required for fitting partial replacement (Dutchman). Make edges of stone at cuts smooth and square to each other and to finished surface. Make back of removal area flat and parallel to stone face.
2. Remove mortar from joints that abut area of stone removal to same depth as stone was removed. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush.
3. Trim partial replacement (Dutchman) to accurately fit area where stone was removed.
4. Apply stone-to-stone adhesive to comply with adhesive manufacturer's written instructions. Coat bonding surfaces of existing stone and partial replacement, completely filling all crevices and voids.
  - a. Apply partial replacement or fit stone fragments onto building stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured.
  - b. Use shims, clamps, wedges, or other devices as necessary to align face of partial replacement with face of stone unit being repaired.
5. After adhesive has fully cured, further anchor partial replacements where indicated with 1/4-inch- diameter, plain stainless-steel rods set into 1/4-inch- diameter holes drilled at a 45-degree downward angle through face of stone. Center and space anchor rods between 3 and 5 inches apart and at least 2 inches from any edge. Insert rods at least 2 inches into backing stone and 2 inches into partial replacements with end countersunk at least 3/4 inch from exposed face of stone.
6. Clean residual adhesive from exposed surfaces.

### 3.4 REPOINTING MASONRY

- A. Rake out and repoint mortar joints to the following extent:
  1. All joints in areas indicated.
  2. Joints where mortar is missing or where they contain holes.
  3. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
  4. Cracked joints where cracks are 1/8 inch or more in width and of any depth.
  5. Joints where they sound hollow when tapped by metal object.
  6. Joints where they are worn back 1/4 inch or more from surface.
  7. Joints where they are deteriorated to point that mortar can be easily removed by hand.
  8. Joints, other than those indicated as sealant-filled joints, where they have been filled with substances other than mortar.
- B. Do not rake out and repoint joints where not required.
- C. Rake out joints as follows:
  1. Remove mortar from joints to depth of 2 times joint width, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.
  2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
  3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

- a. Cut out mortar by hand with chisel and mallet. Do not use power-operated grinders without Architect's written approval based on submission by Contractor of a satisfactory quality-control program and demonstrated ability of operators to use tools without damaging masonry. Quality-control program shall include provisions for supervising performance and preventing damage due to worker fatigue.
  - b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and mallet. Strictly adhere to written quality-control program. Quality-control program shall include provisions for demonstrating ability of operators to use tools without damaging masonry, supervising performance, and preventing damage due to worker fatigue.
- D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- E. Point joints as follows:
1. Rinse masonry-joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen masonry-joint surfaces before pointing.
  2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
  3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer.
    - a. Where existing bricks have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces.
    - b. Take care not to spread mortar over edges onto exposed masonry surfaces or to featheredge mortar.
  4. When mortar is thumbprint hard, tool joints to match original appearance of joints. Remove excess mortar from edge of joint by brushing.
- F. Cure mortar by maintaining in thoroughly damp condition for at least 72 hours including weekends and holidays.
1. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
  2. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.
- G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

### 3.5 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.
1. Do not use metal scrapers or brushes.
  2. Do not use acidic or alkaline cleaners.

- B. Wash adjacent woodwork and other nonmasonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean masonry debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Sweep and rake adjacent pavement and grounds to remove masonry debris. Where necessary, pressure wash surfaces to remove mortar, dust, dirt, and stains.

### 3.6 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare test reports. Coordinate with inspectors and provide access. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

END OF SECTION

SECTION 044300

STONE MASONRY

(Part of Work of Section 040001 - MASONRY WORK, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Stone masonry anchored to concrete backup and to cold-formed metal framing and sheathing.
- B. Items To Be Installed Only: Install the following items as furnished by the designated Sections:
1. Section 055000 - METAL FABRICATIONS:
    - a. Lintels, miscellaneous metal and iron sleeves, anchors, inserts, and plates to be built into masonry walls.
  2. Section 076200 - SHEET METAL FLASHING AND TRIM:
    - a. Through-wall flashings and built-in flashings.
  3. Section 081113 - HOLLOW METAL DOORS AND FRAMES:
    - a. Hollow metal frames in masonry openings.
  4. Section 210001 - FIRE PROTECTION:
    - a. Access doors in masonry openings.
  5. Section 220001 - PLUMBING:
    - a. Access doors in masonry openings.
  6. Section 230001 - HEATING, VENTILATING, AND AIR CONDITIONING:
    - a. Access doors in masonry openings.
    - b. Pipe and duct sleeves for placement into masonry openings.
  7. Section 260001 - ELECTRICAL WORK:
    - a. Access doors in masonry openings.
- C. To Be Furnished Only: Furnish the following items for installation by the designated Sections:
1. Section 033000 - CAST-IN-PLACE CONCRETE:
    - a. Dovetail slots for masonry anchors.
  2. Section 051200 - STRUCTURAL STEEL FRAMING:
    - a. Anchor sections of adjustable masonry anchors for connecting to structural frame.
- D. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 061600 - SHEATHING for sheathing on cold-formed metal framing.

2. Section 072100 - THERMAL INSULATION for cavity insulation and air barrier membrane system.
3. 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.
  1. For stone varieties proposed for use on Project, include test data indicating compliance with physical properties specified or required by referenced ASTM standards.
- B. Samples for Initial Selection: For colored mortar and other items involving color selection.
- C. Samples for Verification:
  1. For each stone type indicated. Include at least five samples in each set for each type of stone, exhibiting extremes of the full range of color and other visual characteristics expected in completed Work.
  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. Weep holes/vents.
  4. Accessories embedded in masonry.
- D. Qualification Data: For qualified Installer.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.
- B. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from one quarry with resources to provide materials of consistent quality in appearance and physical properties.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. 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 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 Designer 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 Designer in writing.

- E. 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 COORDINATION

- A. General: Masonry tie anchors shall be installed during initial mobilization, prior to the application of spray-foam air barrier insulation/membrane. Masonry work shall commence with second mobilization after insulation/membrane has been applied, cured, inspected and touched-up.

#### 1.6 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.

#### 1.7 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 Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- C. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone masonry.
  - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the 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 end of each day to prevent rain from splashing mortar and dirt on completed stone masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or 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.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 STONE, GENERAL

- A. Regional Materials: Provide stone that have been extracted, harvested, or recovered, as well as fabricated, within 500 miles of Project site.
- B. Varieties and Sources: Subject to compliance with requirements, provide one of the stone varieties specified for each stone type in Part 2 "Stone Types" Article.
- C. Match Architect's samples for variety, color, finish, and other stone characteristics relating to aesthetic effects.
- D. Provide stone that is free of cracks, seams, and starts impairing structural integrity or function.
- E. Provide stone from a single quarry for each variety of stone required.
- F. Quarry stone in a manner to ensure that as-quarried block orientations yield finished stone with required characteristics.
- G. Make stone slabs available for Architect to examine for appearance characteristics.
  1. Architect will select aesthetically acceptable slabs and will indicate aesthetically unacceptable slabs and portions of slabs.
  2. Segregate slabs selected for use on Project and mark backs indicating approval.
  3. Mark and photograph aesthetically unacceptable portions of slabs as directed by Architect.

### 2.2 STONE TYPES

- A. Granite: Provide granite complying with ASTM C 615 and NBGQA's "Specifications for Architectural Granite" and as follows:
  1. Varieties, Cut and Finish: As selected by Architect.

## 2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. 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.
- D. Aggregate for Mortar: ASTM C 144. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
- E. Aggregate for Grout: ASTM C 404.
- F. Water: Potable.

## 2.4 VENEER ANCHORS

- A. Materials:
  - 1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
  - 2. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316.
- B. Size: Sufficient to extend at least halfway, but not less than 1-1/2 inches, through stone masonry and with at least 5/8-inch cover on outside face.
- C. 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.
- D. 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.
- E. 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: Provide BL-407 Brick Veneer Anchoring System, manufactured by Blok-Lok. Anchor shall be stainless steel sheet, tie shall be

stainless steel 3/16 in. wire tie. Units consisting of a wire tie section and a metal anchor section complying with the following requirements:

- a. Pintle Shape: Rectangular.
- b. Pintle Length: As required to extend 1-1/2 in. into masonry wythe of veneer face.
- c. Anchor Section: L-shaped plate section with 9/32 in. diameter holes for connecting screws. Eyelets for pintle insertion with 1-1/4 in. maximum allowable eccentricity, sized to prevent in-and-out movement beyond allowable tolerances.

## 2.5 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.

## 2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashings: Furnished under Section 076200 - SHEET METAL FLASHING AND TRIM.

## 2.7 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 sheets, full-depth of cavity extending full height of cavity. Available products:
  1. Advanced Building Products Inc.; Mortar Break II.
  2. Archovations, Inc.; CavClear Masonry Mat.
  3. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
  4. Mortar Net USA, Ltd.; Mortar Net.

## 2.8 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.

## 2.9 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.

## 2.10 FABRICATION

- A. Fabricate stone to comply with sizes, shapes, and tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
- B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated.
- C. Cut and drill sinkages and holes in stone for anchors and supports.
- D. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
  - 1. Clean sawed backs of stone to remove rust stains and iron particles.
- E. Gage backs of stones for adhered veneer if more than 81 sq. in. (522 sq. cm) in area.
- F. Thickness of Stone: Provide thickness indicated, but not less than the following:
  - 1. Thickness: 4 inches plus or minus 1/4 inch. Thickness does not include projection of pitched faces.

- G. Shape stone for type of masonry (pattern) as indicated on the Drawings.
- H. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.
- C. Examine wall framing, sheathing, and insulation/air barrier membrane to verify that stud locations are suitable for spacing of veneer anchors and that installation will result in a weatherproof covering.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

#### 3.3 SETTING OF STONE MASONRY, GENERAL

- A. Perform necessary field cutting and trimming as stone is set.
  - 1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.
- B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones in range ashlar pattern with course heights as indicated, random lengths, and uniform joint widths, with offset between vertical joints as indicated.
- D. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.
- E. Set stone to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

- F. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 1/4 inch at narrowest points or more than 1/2 inch at widest points.
- G. Coat limestone with cementitious dampproofing as follows:
  - 1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches (300 mm) above finish-grade elevations.
  - 2. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.
  - 3. Allow cementitious dampproofing formulations to cure before setting dampproofed stone. Do not damage or remove dampproofing in the course of handling and setting stone.

### 3.4 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.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  - 1. Use open head joints to form weep holes.
  - 2. Space weep holes 24 inches o.c., unless otherwise indicated.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.
- F. Install vents in head joints in exterior wythes at spacing indicated.

### 3.5 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For

external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.
- C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4 inch in 40 feet (19 mm in 12 m) or more.
- D. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

### 3.6 INSTALLATION OF ANCHORED STONE MASONRY

- A. Anchor stone masonry to unit masonry with veneer anchors unless otherwise indicated. Embed anchors in unit masonry mortar joints or grouted cells for distance at least one-half of unit masonry thickness.
- B. Anchor stone masonry to stud framing with screw-attached veneer anchors unless otherwise indicated.
- C. Space anchors not more than 16 inches o.c. vertically and 24 inches o.c. horizontally. Install additional anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.
- D. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as stone is set.
- E. Rake out joints for pointing with mortar to depth of not less than 1/2 inch before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

### 3.7 POINTING

- A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10 mm) deep until a uniform depth is formed.
- B. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
- C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
  - 1. Joint Profile: As indicated.

### 3.8 ADJUSTING AND CLEANING

- A. Remove and replace stone masonry of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
  - 2. Defective joints.
  - 3. Stone masonry not matching approved samples and mockups.

4. Stone masonry not complying with other requirements indicated.
- B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
  1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
  3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
  4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
  5. Clean limestone masonry to comply with recommendations in ILI's "Indiana Limestone Handbook."

### 3.9 EXCESS MATERIALS AND WASTE

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  1. Crush masonry waste to less than 4 inches in each dimension.
  2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 - EARTHWORK.
  3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Site.

END OF SECTION

SECTION 055000  
METAL FABRICATIONS

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. Miscellaneous steel framing and supports:

- a. Steel framing and supports with shop applied primer for operable partitions.
- 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.

2. Ladders:

- a. Steel ships' ladders with shop-applied primer.

- 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.

- 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 055150 - METAL RAILINGS for steel handrails and guardrails.
3. Section 099000 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and miscellaneous framing and supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

1. For ladders exceeding 24 feet, include loads imposed by fall arrest system.
  - C. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
    1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- 1.4 SUBMITTALS
- A. Product Data: For each product.
  - B. Shop Drawings: Show fabrication and installation details for metal fabrications.
    1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
    2. Provide templates for anchors and bolts specified for installation under other Sections.
    3. Where fabrications are to receive sprayed-on fireproofing, include statement that primer is compatible with fireproofing proposed for use.
  - C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - D. Welding certificates.
  - E. Qualification Data: For professional engineer.
- 1.5 QUALITY ASSURANCE
- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
  - B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated for this Project in material, design, and extent.
  - C. Welding: Qualify procedures and personnel according to the following:
    1. AWS D1.1, "Structural Welding Code--Steel."
    2. AWS D1.3, "Structural Welding Code--Sheet Steel."
  - D. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide allowance for trimming and fitting at site.

## 1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 FERROUS METALS

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. 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. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- F. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.
  - 1. Basis of Design: Unistrut Corp.

## 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. Available Products: Tnemec; Series 394 PerimePrime, or approved equal.
  - 2. VOC Content: 250 g/L or less.
- D. Galvanizing Repair Paint: High-zinc-dust-content (95% by weight) paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
  - 1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Duncan Galvanizing; ZIRP.
  - b. ZRC Worldwide; Galvilite Galvanizing Repair, low VOC type.
  2. VOC Content: 250 g/L or less.
- E. Isolation Coating (Bituminous Paint): ASTM D 1187, cold-applied asphalt emulsion, VOC compliant, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dayton Superior; 1107 Advantage Grout.
    - b. Sika; SikaGrout 212.
  2. VOC Content: 0 g/L.

#### 2.4 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 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.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

## 2.7 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.

## 2.8 METAL SHIPS' LADDERS

- A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers, pipe and tube railings, and bar grating treads, unless otherwise indicated. Provide brackets and fittings for installation.

## 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. Available Products: Tnemec; Series 394 PerimePrime, or approved equal.
  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.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

### 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 055150

METAL RAILINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Steel handrails, guardrails, and railings, at exterior locations.
  - 2. Steel handrails, guardrails, and railings, with shop-applied zinc-rich primer at interior locations.
- 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 sleeves, anchors, inserts, plates and similar items.
  - 2. Section 061000 - ROUGH CARPENTRY for wood blocking for anchoring railings.
  - 3. Section 092110 - GYPSUM BOARD ASSEMBLIES for metal backing for anchoring railings.
  - 4. Section 099000 - PAINTING AND COATING for field painting work of this section.

1.3 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. 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:
- C. 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 metal railings and the following:
  - 1. Paint products, including printed statement of VOC content.

2. Grout, including printed statement of VOC content.
- 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.
- 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. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- E. Welding certificates.
- F. 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 stairs and railings that are similar to those indicated for this Project in material, design, and extent.
- C. Installer Qualifications: Fabricator of products.
- D. Welding: Qualify procedures and personnel according to the following:
  1. AWS D1.1, "Structural Welding Code--Steel."
  2. AWS D1.3, "Structural Welding Code--Sheet Steel."

#### 1.7 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 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. 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.

### 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. 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.
- D. 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 stainless steel Type 316 for exterior use and where built into exterior walls. Select fasteners for type, grade, and class required.
- 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.

### 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. Available Products: Dupont Ganicin, Keeler and Long Urethane Zinc Rich Primer, or Tnemec Series 394 PerimePrime.

- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
  - 1. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- 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.

## 2.5 FABRICATION, GENERAL

- A. Provide complete assemblies, including metal framing, railings, clips, brackets, bearing plates, and other components necessary to support and anchor railings to supporting structure.
  - 1. Join components by welding, unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- 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 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.
- 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 joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

## 2.6 METAL 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.

## 2.7 STEEL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal railings after assembly.
- C. 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.
- D. 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. Interior Railings (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- E. Apply shop primer to uncoated surfaces of metal railing 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 railings 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 railings. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal railings by welding railing 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.

#### 3.2 INSTALLING METAL 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 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.
- C. 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 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 055150 - METAL RAILINGS for other 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.
  - 2. Steel: 72 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.
- E. Wire Rope: 1 x 19 wire rope made from wire complying with ASTM A 492, Type 316.
- F. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

## 2.4 STEEL AND IRON

- A. Tubing: ASTM A 500/A 500M (cold formed) or ASTM A 513.
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

## 2.5 FASTENERS

- A. General: Provide the following:
  - 1. Stainless-Steel Components: Type 316 stainless-steel fasteners.
  - 2. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
  - 3. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
  - 4. 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.

## 2.6 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. Available Products: Sika; SikaGrout 212; or approved equal.
  - 2. VOC Content: 0 g/L.

## 2.7 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.

## 2.8 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.

## 2.9 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.

## 2.10 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 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 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 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 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 061600 - SHEATHING for plywood sheathing.
  2. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for interior woodwork not specified in this Section.
  3. 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: AWWA 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. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Henkel Corp.; Loctite PL Premium Polyurethane Construction Adhesive.
    - b. Henkel Corp.; OSI SF450 Heavy Duty Subfloor Construction Adhesive.

2. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. VOC Content: 70 g/L or less.
4. Do not use adhesives that contain urea formaldehyde.
5. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Apply field treatment complying with AWWPA 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. 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. Pre-drill 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. Wall and roof sheathing.
2. Subflooring.
3. Underlayment.

- 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 framing and miscellaneous plywood backing panels.
2. Section 076200 - SHEET METAL FLASHING AND TRIM for flashing applied to sheathing.

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

- B. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.

3. Power-driven fasteners.

#### 1.4 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.
- B. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
  1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

### PART 2 - PRODUCTS

#### 2.1 WOOD PANEL PRODUCTS

- A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

#### 2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
  1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

#### 2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-

test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Exterior and Interior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings, and the following:
  - 1. Roof sheathing.

## 2.4 PLYWOOD SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
  - 1. Span Rating: As indicated on Structural Drawings.
  - 2. Nominal Thickness: Not less than 1/2 inch
  - 3. Edges: Square.
- B. Plywood Roof Sheathing: Exterior, Structural I sheathing.
  - 1. Span Rating: As indicated on Structural Drawings.
  - 2. Nominal Thickness: Not less than 3/4 inch.
  - 3. Edges: Tongue and groove.

## 2.5 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing.
  - 1. Span Rating: As indicated on Structural Drawings.
  - 2. Nominal Thickness: Not less than 3/4 inch.
  - 3. Edges: Tongue and groove.
  - 4. Face: C-D plugged.
- B. Sound Control Underlayment:
  - 1. Basis of Design: Homasote Company; 440 Sound Barrier (and NCFR Homasote for fire-rated assemblies).

2. Nominal Thickness: Not less than 3/4 inch.
3. Edges: Square.

## 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. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
  2. For pressure-preservative treated sheathing, provide fasteners of Type 304 stainless steel only.
- B. Nails, 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: ASTM C 1002.
- E. Screws for Fastening Wood Structural Panels 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.
  1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
  2. For pressure-preservative treated sheathing, provide fasteners of Type 304 stainless steel only.

## 2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
  1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following, as applicable:
  1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

2. ICC-ES evaluation report for fastener.

- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with air/vapor retarders, flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

- a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
- b. Screw to cold-formed metal framing.
- c. Space panels 1/8 inch apart at edges and ends.

2. Subflooring:

- a. Glue and nail to wood framing.
- b. Screw to cold-formed metal framing.
- c. Space panels 1/8 inch apart at edges and ends.

3. Underlayment:

- a. Nail or staple to subflooring.
- b. Space plywood panels 1/32 inch apart at edges and ends.
- c. Space sound control panels 1/8 inch apart at edges and ends.

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 siding and trim.
  - 2. Exterior wood deck.
- 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 barrier system.
  - 2. Section 072100 - THERMAL INSULATION for insulation in studs.
  - 3. Section 076200 - SHEET METAL FLASHING AND TRIM for metal flashings.
  - 4. Section 079200 - JOINT SEALANTS for field-applied sealants not otherwise specified in this Section.
  - 5. Section 099000 - PAINTING AND COATING for field-finishing work of this Section.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Indicate location and nailing pattern for exposed surface nailing, as required by project conditions.
- C. Samples for Verification: For each type, color, texture, and pattern required.
  - 1. 12-inch-long-by-actual-width Sample of siding, soffits and trim.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation 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 014330 - MOCKUPS.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Meet with the Owner Project Manager; Architect, Owner insurer if applicable; testing and inspecting agency representative; siding Installer; siding manufacturer's senior representative; sheathing and air barrier Installer; and installers whose work interfaces with or affects siding, including installers of windows and doors.
2. Review methods and procedures related to siding 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 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 siding installation only if substrate is completely dry and if existing and forecasted weather conditions permit siding to be installed according to manufacturer's written instructions.

#### 1.7 SEQUENCING

- A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace siding that does not comply with requirements or that fails within specified warranty period. Failures include, but are not limited to, cracking, deforming, fading, or otherwise deteriorating beyond normal weathering.
  1. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than Hunter color-difference units as measured according to ASTM D 2244.
  2. Warranty Period: 15 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. 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.
- B. 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.

## 2.2 ACCESSORIES

- A. Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Flashing: Provide metal flashing complying with Section 076200 - SHEET METAL FLASHING AND TRIM at window and door heads and where indicated.
- C. 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 linseed-based wood stain selected for the exposed face.

## 2.4 EXTERIOR WOOD SIDING AND TRIM

- A. Provide Eastern White Cedar siding, Clear Grade, absolutely no knots, Plain Sawn:
  1. Exposure: As indicated.
  2. Profile: As indicated.
  3. Sizes and Shapes: As indicated on the Drawings.

## 2.5 WOOD DECKING

- A. Board Decking: Radius-edged S4S boards, with one face free of planer skip, machine burn, and torn or chipped grain.
  1. Species: Ipe.
  2. Grade Characteristics:
    - a. Clear one face; small pin knots and worm holes will be accepted on back face.
    - b. Sound; small pin knots, worm holes, and fixed knots will be accepted.

- c. All heart one face.
  - d. Straight grained and parallel cut.
  - e. Free of heart centers.
  - f. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wane.
  - g. No discoloration.
3. Maximum Moisture Content: 15 percent.

## 2.6 SHOP PAINT

- A. Linseed Based Wood Stains: Provide products of one of the following manufacturers that meet or exceed specified requirements:
1. Samuel Cabot, Inc. (Cabot) "Clear Solutions," "Bleaching Oil 6241"
  2. Olympic Stain. (Olympic) "Weathering Stain" 350 g/l VOC max.
- B. Application: Provide one coat of stain on all sides of each piece, at spreading rate recommended by stain manufacturer for exterior wood siding, soffits, and trim. Color shall match Architect's sample.

## 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: Comply with siding manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
1. Do not install damaged components.
  2. Center nails in elongated nailing slots without binding siding to allow for thermal movement.
  3. Cut edges shall be sealed with wood stain selected for the exposed face finish.
- B. 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.
- C. 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.
- D. 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.
- E. Install joint sealants as specified in Section 079200 - 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. Stairwork and rails.
  2. Wood casework.
  3. Solid-surfacing-material countertops.
  4. Closet and utility shelving.
  5. Shop finishing of interior woodwork.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 061000 - ROUGH CARPENTRY for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
  2. Section 099000 – PAINTING AND COATING for field finishing work of this Section.

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. Solid-surfacing materials, 6 inches square.

D. Qualification Data: For Installer and fabricator.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with blueprint-matched wood veneers and components.
- C. Quality Standard: Unless otherwise indicated, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards," latest edition, including errata, for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
  - 1. The HVAC systems as specified elsewhere may not provide for humidity controls. The expected ranges of relative humidity are expected to be as high as 55% to a low of uncontrolled during the heating system. Comply with AWS Section 2, Care and Storage.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

## PART 2 - PRODUCTS

### 2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

### 2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI/AWMAC/WI's "Architectural Woodwork Standards" for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. 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. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISFA-2.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Avonite Surfaces; Aristech Surfaces.
    - b. E. I. du Pont de Nemours and Company; Corian.
    - c. Formica Corporation.
    - d. LG Hausys; Hi-Macs.
    - e. Wilsonart LLC.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.
1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
  2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:

1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
  2. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
  3. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. Fire-Retardant Fiberboard and Particleboard: Provide five ply construction with crossbands to prevent any ammonia fuming from the core to the face veneers.

#### 2.4 CASEWORK HARDWARE AND ACCESSORIES

- A. General: Provide casework hardware and accessory materials associated with architectural casework, except for items specified in Section 087100 - DOOR HARDWARE.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602,100 degrees of opening, self-closing.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
- D. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112.
- F. Drawer Slides: BHMA A156.9, 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.

## 2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Handrail Brackets: Cast from malleable iron with wall flange drilled [for exposed anchor and with support arm for screwing to underside of rail. Sized to provide 1-1/2-inch clearance between handrail and wall.
- D. Installation Adhesives and Wood Glues: Formulations approved for use indicated by adhesive manufacturer.
  - 1. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  - 2. VOC Limits: Use installation adhesives that comply with the following limits for VOC content:
    - a. Wood Glues: 30 g/L.
    - b. Contact Adhesives: Not permitted on the Project without Architect's prior approval.
  - 3. Do not use adhesives that contain urea formaldehyde.
  - 4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

## 2.6 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- B. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Casework and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or

roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

F. Install glass to comply with applicable requirements in Section 088000 - GLAZING and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

## 2.7 STAIRWORK AND RAILS

A. Grade: Custom.

B. Wood Species and Cut for Transparent Finish: As specified hereinabove.

C. Wood Species for Opaque Finish: Any closed-grain hardwood, except that eastern white pine, sugar pine, or western white pine may be used for risers, stringers, and moldings.

D. Finishes for Stair Parts: As follows:

1. Treads: Transparent.
2. Risers: Opaque.
3. Stringers: Opaque.
4. Balusters: Opaque.
5. Handrails: Transparent.
6. Cove and Other Moldings: Opaque.

E. Cut carriages to accurately fit treads and risers. Glue treads to risers, and glue and nail treads and risers to carriages.

1. House wall and face stringers and glue and wedge treads and risers.
2. Fabricate stairs with treads and risers no more than 1/8 inch from indicated position and no more than 1/16 inch out of position for adjacent treads and risers.

## 2.8 WOOD CASEWORK FOR TRANSPARENT FINISH

A. Grade: Custom.

B. AWI Type of Casework Construction: Flush overlay.

C. Wood Species and Cut for Exposed Surfaces: As specified hereinabove.

1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
2. Matching of Veneer Leaves: Book match.
3. Vertical Matching of Veneer Leaves: End match.
4. Veneer Matching within Panel Face: Running match.
5. Veneer Matching within Room: Provide casework veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.

D. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.

2. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
  3. Drawer Bottoms: Hardwood plywood.
- E. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.

## 2.9 WOOD CASEWORK FOR OPAQUE FINISH

- A. Grade: Custom.
- B. AWI Type of Casework Construction: Flush overlay.
- C. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.
- D. Panel Product for Exposed Surfaces: Medium-density overlay.
- E. Semiexposed Surfaces: Provide surface materials indicated below:
  1. Surfaces Other Than Drawer Bodies: Match materials indicated for exposed surfaces.
  2. Drawer Sides and Backs: Solid-hardwood lumber.
  3. Drawer Bottoms: Hardwood plywood.

## 2.10 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Grade: Custom.
- B. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
  1. As selected by Architect from manufacturer's full range.
- C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
  1. Fabricate tops with shop-applied edges of materials and configuration indicated.
  2. Fabricate tops with loose backsplashes for field application.
- D. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

## 2.11 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.

## 2.12 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. Shop Priming: Shop apply the prime coat including backpriming, if any, for opaque-finished items specified to be field finished. Refer to Section 099000 - PAINTING AND COATING for material and application requirements.
- D. 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. Stairs: Securely anchor carriages to supporting substrates. Install stairs with treads and risers no more than 1/8 inch from indicated position.
- H. Railings:
  - 1. General: Install rails with no more than 1/8 inch in 96-inch variation from a straight line.
  - 2. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.
  - 3. Wall Rails: Support rails on indicated metal brackets securely fastened to wall framing.
- I. Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install casework with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Attach casework to walls with mechanical fasteners. Do not use adhesives, so that casework may be removed and salvaged in the future.
- J. 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.
- K. 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 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)

PROJECT IDENTIFICATION: Orleans Community Building

SUB-BID FOR SECTION: 070001 – WATERPROOFING, DAMPPROOFING  
AND CAULKING.

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: *To be inserted with final documents*

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 - SHEET WATERPROOFING
2. All Work of Section 071400 - FLUID-APPLIED WATERPROOFING
3. 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)

PROJECT IDENTIFICATION: Orleans Community Building

SUB-BID FOR SECTION: 070002 – ROOFING AND FLASHING

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: *To be inserted with final documents.*

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. All Work of Section 073113 - ASPHALT SHINGLES
2. All Work of Section 075300 - EPDM ROOFING
3. All Work of Section 076200 - SHEET METAL FLASHING AND TRIM

END OF SECTION

SECTION 071300

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. Post-applied, 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. Post-Applied Sheet Waterproofing:
    - a. Rubberized-Asphalt Sheet Waterproofing:
      - 1) American Hydrotech, Inc.; VM 60.
      - 2) Carlisle Corporation, Carlisle Coatings & Waterproofing Div.; MiraDRI 860/861.
      - 3) Cetco; Envirosheet.
      - 4) GCP Applied Technologies (formerly W.R. Grace); Bituthene 3000.
      - 5) Henry Company; WP 200

### 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 071400

FLUID-APPLIED WATERPROOFING

(Part of Work of Section 070001 - Waterproofing, Dampproofing and Caulking,  
Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Latex-rubber waterproofing membrane.
  2. Molded sheet drainage panels.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 072100 - THERMAL INSULATION for insulation at foundations and under slabs.
  2. Section 079200 - JOINT SEALANTS for joint-sealant materials and installation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Samples: For the following products:
1. 12-by-12-inch square of waterproofing and reinforcing strip.
  2. 12-by-12-inch square of drainage panel.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is acceptable to waterproofing manufacturer to install manufacturer's products.

- B. Source Limitations: Obtain waterproofing materials, protection course, and molded-sheet drainage panels through one source from a single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Protect stored materials from direct sunlight.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.
  - 1. Warranty insulation will retain 80 percent of original published thermal value.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Installer's Warranty: Signed by Installer, covering Work of this Section, for warranty period of two years.
  - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.

### PART 2 - PRODUCTS

#### 2.1 LATEX-RUBBER WATERPROOFING

- A. Two-Component, Unreinforced, Latex-Rubber Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.

1. Basis of Design: GCP Applied Technologies (formerly W.R. Grace); Procor.

## 2.2 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.
- B. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- C. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.
  1. Backer Rod: Closed-cell polyethylene foam.

## 2.3 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to 1 side with a polymeric film bonded to the other side of a 3-dimensional (studded), nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).
  1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Hydrotech, Inc.; Hydrodrain 420.
    - b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRAIN 6200 series.
    - c. GCP Applied Technologies (formerly W.R. Grace); Hydroduct 220 vertical, 660 horizontal.
    - d. Henry Company; DB 220 vertical, DB 650 horizontal.
    - e. Sika Sarnafil Inc.; Drainage Panel 900 series.
    - f. Tremco Inc. TREMDrain 1000 or TREMDrain 2000.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
  2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

### 3.3 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
  - 1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
  - 2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
  - 3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.
    - a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

### 3.4 MEMBRANE APPLICATION

- A. Apply waterproofing according to ASTM C 898 and manufacturer's written instructions.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer over prepared substrate.
- D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
  - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.
  - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
  - 3. Verify wet film thickness of waterproofing every 100 sq. ft.

3.5 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.6 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed waterproofing from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 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. Mineral-wool blanket insulation.
  - 2. Vapor retarders.
- 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 075300 - EPDM ROOFING for roofing insulation.
  - 3. Section 092110 - GYPSUM BOARD ASSEMBLIES for acoustic insulation in gypsum board assemblies.
  - 4. Division 22 - PLUMBING for plumbing insulation.
  - 5. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for mechanical insulation.

1.3 SUBMITTALS

- A. Product Data: Manufacturer product data, installation instructions, performance criteria, and product limitations for each type of product indicated.
- B. Qualification Data: For Testing Agency.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Testing Agency Qualifications: An independent agency qualified as a "Certified Infrared Thermographer" per ASNT SNT-TC-1A guidelines, Level I certification minimum.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store in a dry and secure location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver materials to Project site before installation time.
  - 3. Complete installation and concealment of materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 BLANKET INSULATION, MINERAL-WOOL BLANKET

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Owens Corning; Thermafiber UltraBatt FF.
  - 2. Isolatek International.
  - 3. Rockwool (formerly Roxul).
- B. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 1. Recycled Content: 70 percent min.
  - 2. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
  - 3. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification, formaldehyde-free.
- C. Mineral-Wool Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene. GreenGuard certified as formaldehyde free and low chemical emissions.

### 2.2 SPRAYED-FOAM INSULATION, AT GAPS AND VOIDS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Dow Chemical; GreatStuff Pro.
  - 2. ICP Adhesives and Sealants (formerly Fomo Products): Handi-Foam products.
  - 3. Approved equal.
- B. Sprayed-Foam Insulation: Water-cure closed cell polyurethane containing no urea-formaldehyde and no CFCs.

1. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 4.0 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Fire Resistance: UL 723, Flame Spread 25 max., and Smoke Developed 50 max.
3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Industry-wide EPD.
4. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

### 2.3 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.

### 2.4 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
  1. Low-Emitting Materials: Provide interior adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  2. Do not use adhesives that contain urea formaldehyde.
  3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
- B. Masonry and Concrete Fasteners:
  1. Hardened nails, pneumatically-driven fasteners or other anchors recommended by insulation manufacturer, sufficient to penetrate substrate and permanently retain insulation.
  2. Self-adhering insulation stick pins: Galvanized steel plate welded to projecting steel spindle; capable of holding insulation thicknesses indicated securely in position indicated with self-locking galvanized steel washer in place. Backseal fastener penetrations.
- C. Tape: Adhesive tape recommended by insulation manufacturer, to tape joints and tears in faced insulation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

### 3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Miscellaneous Voids: Install spray polyurethane foam insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.
  - 1. Cure insulation with continuous natural or mechanical ventilation.
  - 2. Remove and dispose of over-spray.

### 3.4 INSTALLATION OF 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.

### 3.5 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
  - 1. Attach vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints.
  - 2. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.6 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 072500  
WEATHER BARRIERS

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. Building wrap.
- 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 joint and penetration treatment.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Evaluation Reports: For water-resistive barrier, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. DuPont; Styrofoam Weathermate Plus Brand Housewrap.
    - b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
    - c. Reemay, Inc.; Typar HouseWrap.
  - 2. Water-Vapor Permeance: Not less than 75 g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).
  - 3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.

4. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

C. Sill Sealer: Provide 1/4 inch uncompressed thickness, closed cell polyethylene foam plastic, with compressive strength of 1.0 psi, 1 .5 to 2.2 pcf density. Provide widths to coordinate with width of sill members used. Provide in continuous long rolls to minimize joints.

1. Acceptable Product: DuPont "Styrofoam Brand Sill Seal" or equal.

## 2.2 FLEXIBLE FLASHING AND RELATED MATERIALS

A. Acceptable Manufacturers:

1. Carlisle Coatings and Waterproofing; Miradri TWF.
2. Carlisle Coatings and Waterproofing; CCW 705 TWF.
3. GCP Applied Technologies (formerly W.R. Grace); Perm-A-Barrier.
4. GCP Applied Technologies (formerly W.R. Grace); VycorV40.

B. Provide composite membrane of minimum 32 mils of rubberized asphalt bonded to 8 mils of high density, cross-laminated polyethylene film to form a self-adhering membrane sheet flashing. Provide minimum 12 inch wide strips of flashing if not indicated otherwise.

C. Associated Materials: Provide all primers, sealers, surface conditioners, edge sealants, fillers, adhesives, cants, mastics, and other miscellaneous materials and accessories recommended by the flashing manufacturer. To ensure compatibility, provide only associated materials that are either supplied or approved in writing by the flexible flashing manufacturer.

D. Use Limitations and Metal Flashing Substitution: At the following locations and conditions, do not use specified membrane flexible flashing but provide break formed sheet metal flashing with fully soldered seams:

1. Wherever flashing would be exposed to sunlight.
2. Wherever flashing is not fully supported such as when spanning a cavity wall or unsupported open space.
3. At locations where sealant is adhered directly to the flashing.
4. Where flashing cannot be properly installed due to its self-adhesive properties. Window jambs may such a condition.
5. Wherever flashing is indicated or noted to be metal.
6. Wherever flashing would be in contact with creosote, coal tar, or polysulfide joint sealants.
7. Wherever substrate surface or ambient air temperature is below 25 degrees F.

E. Metal Flashing Supplements: Provide sheet metal flashing supplements at the following locations and elsewhere indicated:

1. Gaps: Provide minimum 6 inch wide strip of sheet metal under flexible membrane flashing to help support flexible flashing at gaps between continuous lintels and shelf angles.
2. Drips: Provide minimum 4 inch wide strip of sheet metal where the flexible flashing is indicated to protrude from the construction assembly and would be exposed to sunlight. Overlap the membrane flashing at least 2.5 inches onto the sheet metal and extend the sheet metal out of the construction assembly and form a drip. Provide butt joints

between metal flashing membranes. Use longest practical lengths of metal flashing drip edges.

- F. Sheet Metal Material - Copper: Minimum 16 ounce, ASTM B370 cold rolled copper.
  - 1. Solder: ASTM B32, 50/50 tin/lead solder with rosin flux.

### PART 3 - EXECUTION

#### 3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
  - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
  - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions.
  - 1. Seal seams, edges, fasteners, and penetrations with tape.
  - 2. Extend into jambs of openings and seal corners with tape.

END OF SECTION

SECTION 073113

ASPHALT SHINGLES

(Part of Work of Section 070002 - Roofing and Flashing, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Asphalt shingles.
  - 2. Underlayment.
  - 3. Snow guards.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 061000 - ROUGH CARPENTRY for wood nailers and cants.
  - 2. Section 076200 - SHEET METAL FLASHING AND TRIM.

1.3 DEFINITION

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For the following products, of sizes indicated, to verify color selected:
  - 1. Asphalt Shingle: Full size.
  - 2. Ridge and Hip Cap Shingles: Full size.
  - 3. Ridge Vent: 12-inch-long Sample.
  - 4. Exposed Valley Lining: 12 inches square.
  - 5. Self-Adhering Underlayment: 12 inches square.
  - 6. Snow Guard: Base, bracket, and 12-inch-long rail.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for asphalt shingles.
- D. Maintenance Data: For each type of asphalt shingle to include in maintenance manuals.

- E. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain ridge and hip cap shingles ridge vents from single source from single manufacturer.
- B. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
  - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790, for application and roof slopes indicated.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups for asphalt shingles including related roofing materials.
    - a. Size: 48 inches long by 48 inches wide.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to roofing system including, but not limited to, the following:
  - 1. Meet with the Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  - 5. Review structural loading limitations of roof deck during and after roofing.
  - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
  - 7. Review governing regulations and requirements for insurance and certificates if applicable.
  - 8. Review temporary protection requirements for roofing system during and after installation.
  - 9. Review roof observation and repair procedures after roofing installation.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
  - 1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.
- B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

## 1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing to be performed according to manufacturer's written instructions and warranty requirements.

## 1.8 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Manufacturing defects.
    - b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.
  - 2. Material Warranty Period: 30 years from date of Substantial Completion, prorated, with first three years nonprorated.
  - 3. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor five years from date of Substantial Completion.
- B. Special Project Warranty: Roofing Installer's Warranty, signed by roofing Installer, covering Work of this Section, in which roofing Installer agrees to repair or replace components of roofing that fail in materials or workmanship within the following warranty period:
  - 1. Warranty Period: Two years from date of Substantial Completion.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Asphalt Shingles: 25 sq. ft of each type, in unbroken bundles.

## PART 2 - PRODUCTS

### 2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Environmental Product Declarations (EPD): Industry-wide EPDs for asphalt shingles are available from the Asphalt Roofing Manufacturers Association (ARMA).

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Atlas Roofing Corporation.
  - 2. CertainTeed Corporation.
  - 3. GAF Materials Corporation.
  - 4. IKO.
  - 5. Owens Corning.
- C. Laminated-Strip Asphalt Shingles: ASTM D 3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
  - 1. Algae Resistance: Granules treated to resist algae discoloration.
  - 2. Color and Blends: As selected by Architect from manufacturer's full range.

## 2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil-thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Carlisle Coatings & Waterproofing, Inc.
    - b. GCP Applied Technologies (formerly W.R. Grace).
    - c. Henry Company.
- B. Felt: ASTM D 226, Type II, asphalt-saturated organic felts, nonperforated.

## 2.3 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent with nonwoven geotextile filter strips; for use under ridge shingles.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Vent, Inc.; a Gibraltar Industries company.
    - b. Cor-A-Vent, Inc.
    - c. GAF Materials Corporation.

## 2.4 SNOW GUARDS

- A. Snow-Guard Pads: Fabricated stainless-steel units, designed to be installed without penetrating shingles, and complete with predrilled holes or hooks for anchoring.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
  - b. M. J. Mullane Company, Inc.
  - c. SnoGuard.
  - d. Snow Management Systems.
  - e. Zaleski Snow-Guards for Roofs, Inc.
- B. Snow-Guard Rails: Units fabricated from metal baseplate anchored to fixed bracket and equipped with three bars.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
    - b. M. J. Mullane Company, Inc.
    - c. SnoGuard.
    - d. Snow Management Systems.
  2. Brackets and Baseplate: Stainless steel.
  3. Bars: Stainless steel, mill finished.

## 2.5 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch-diameter, barbed shank, sharp-pointed, with a minimum 3/8-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.
1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.

## 2.6 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 076200 - SHEET METAL FLASHING AND TRIM.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
  2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.

- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below, lapped in direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.
  - 1. Eaves: Extend from edges of eaves 36 inches beyond interior face of exterior wall.
  - 2. Rakes: Extend from edges of rake 36 inches beyond interior face of exterior wall.
  - 3. Valleys: Extend from lowest to highest point 18 inches on each side.
  - 4. Hips: Extend 18 inches on each side.
  - 5. Ridges: Extend 36 inches on each side without obstructing continuous ridge vent slot.
  - 6. Sidewalls: Extend beyond sidewall 18 inches and return vertically against sidewall not less than 4 inches.
  - 7. Dormers, Chimneys, Skylights, and Other Roof-Penetrating Elements: Extend beyond penetrating element 18 inches and return vertically against penetrating element not less than 4 inches.
  - 8. Roof Slope Transitions: Extend 18 inches on each roof slope.
- C. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with [felt underlayment] [roofing] nails.
  - 1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction to shed water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.

### 3.3 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 - SHEET METAL FLASHING AND TRIM.
  - 1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

### 3.4 ASPHALT SHINGLE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with self-sealing strip face up at roof edge.
  - 1. Extend asphalt shingles 3/4 inch over fasciae at eaves and rakes.
  - 2. Install starter strip along rake edge.
- C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.
- E. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches beyond center of valley. Use one-piece shingle strips without joints in valley. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches short of valley centerline. Trim upper concealed corners of cut-back shingle strips.
  - 1. Do not nail asphalt shingles within 6 inches of valley center.
  - 2. Set trimmed, concealed-corner asphalt shingles in a 3-inch-wide bed of asphalt roofing cement.
- F. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- G. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.
  - 1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

### 3.5 SNOW-GUARD INSTALLATION

- A. Snow-Guard Pads: Install snow-guard pads at locations indicated according to manufacturer's written installation instructions.
- B. Snow-Guard Rails: Install snow-guard rails at locations indicated according to manufacturer's written installation instructions.

END OF SECTION

SECTION 075300

EPDM 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. Vapor retarder.
  5. 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 drains.
  2. Section 230001 - HEATING, VENTILATING, AND AIR CONDITIONING:
    - a. Roof curbs for HVAC equipment.
- C. Items To Be Furnished Only: Not Applicable.
- D. 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.

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.
  - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
  - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- 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 (Fifth Edition) for Construction Details and SMACNA Architectural Sheet Metal Manual (Seventh 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. Tapered insulation, including slopes.
  - 3. 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. 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.
- C. Roofing Signage: At entry points to roof, provide signage-listing type of roofing system, manufacturer, date installed, and holder of the warranty.
- 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 EPDM ROOFING MEMBRANE

- A. EPDM Roofing Membrane: ASTM D 4637, Type I, nonreinforced uniform, flexible sheet made from EPDM, and as follows:
  - 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 SynTec Incorporated.
    - b. Firestone Building Products Company.
    - c. Johns Manville International, Inc.
    - d. Mule-Hide Products Co., Inc.
    - e. Versico Inc.
  - 2. Thickness: 60 mils (1.5 mm) nominal.

3. Exposed Face Color: Black.

## 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: 60-mil-thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- D. Seaming Material: Manufacturer's standard synthetic-rubber polymer primer and 3-inch- wide minimum with cover strip or 6-inch-wide, butyl splice tape with release film.
- E. Lap Sealant: Manufacturer's standard single-component sealant, color to match roofing membrane.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. 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.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

## 2.3 VAPOR RETARDER

- A. Self-Adhering Sheet Vapor Retarder: ASTM D 1970, minimum 40-mil- thick film laminated to layer of rubberized asphalt adhesive; maximum permeance rating of 0.1 perm; cold-applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

## 2.4 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Atlas Roofing Corporation.
    - b. Carlisle SynTec Incorporated.
    - c. Firestone Building Products Company.
    - d. GAF Materials Corp.
    - e. GenFlex Roofing Systems.
    - f. Johns Manville International Inc.
- 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 1278/C 1278M, cellulosic-fiber reinforced, water-resistant gypsum substrate, 1/2 or 5/8 inch thick.

## 2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that surface plane flatness and fastening of steel roof deck comply with requirements in Section 053100 - STEEL DECKING.
  - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
  - 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
  - 7. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.3 VAPOR-RETARDER INSTALLATION

- A. Self-Adhering Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering sheet vapor retarder over area to receive vapor retarder, side, and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.
- B. Completely seal vapor retarder at side laps, end laps, terminations, obstructions, and penetrations to prevent air movement into roofing system.

### 3.4 INSULATION AND COVERBOARD INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.

- D. Install one or more layers of insulation under area of roofing to achieve required thickness. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
  - E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
  - F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
    - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
    - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
    - 2. For insulation applied in multiple layers, loose-lay first layer and mechanically fasten top layer.
  - H. Mechanically Fastened Cover Boards: Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and mechanically fasten to roof deck.
    - 1. Mechanically fasten cover boards, unless otherwise indicated.
    - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
  - 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.
- 3.5 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 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. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
- H. Repair tears, voids, and lapped seams in roofing that does not meet requirements.
- I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

### 3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply 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, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings.

### 3.7 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Manufacturer's Technical Representative: Engage a qualified manufacturer's technical representative to perform roof tests and inspections and to prepare test reports.
- C. Final Roof Inspection: Engage roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
  - 1. Notify Architect and the Owner 48 hours in advance of date and time of inspection.
- D. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.9 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and the Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 076200

SHEET METAL FLASHING AND TRIM

(Part of Work of Section 070002 - ROOFING AND FLASHING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Sheet metal flashing and trim for the following applications:
    - a. Through-wall flashing.
    - b. Formed wall flashing and trim.
    - c. Formed low-slope roof flashing and trim.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 061000 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
  2. Section 075300 - EPDM ROOFING for installing sheet metal flashing and trim integral with roofing membrane.
  3. 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.
- E. Interface with Other Systems:
  - 1. Do not proceed with installation of flashing and sheet metal until completion of curb and substrate construction, cants, blocking, reglets and other construction required to receive flashing.
  - 2. Coordinate flashing with other Work for correct sequencing of items comprising entire membrane or system of roofing or waterproofing and rain drainage.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identify material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
  - 4. Details of expansion-joint covers, including showing direction of expansion and contraction.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.
  - 2. Trim: 12 inches long. Include fasteners and other exposed accessories.
  - 3. Accessories: Full-size Sample.

#### 1.5 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
  - 1. Meet with the Owner, Architect and Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
  - 2. Review methods and procedures related to sheet metal flashing and trim.
  - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

## 1.7 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

## PART 2 - PRODUCTS

### 2.1 SHEET METALS

- A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005. Thickness as specified in this Section. Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
  - 1. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
    - a. Color and Gloss: As selected by Architect from manufacturer's full range.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, with No. 2D dull, cold-rolled finish. Thickness as specified in this Section.

### 2.2 UNDERLAYMENT MATERIALS

- A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- B. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
  - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
  - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
  - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

- C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Isolation Coating: ASTM D 1187, cold-applied asphalt emulsion, VOC compliant, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

#### 2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength. Provide 2 in. min. end dams at terminations (riveted and sealed watertight).
  - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 3. Soldered Seams in Stainless Steel: Prefabricated inside and outside corners and 2 in. min. end dams at terminations (riveted and soldered watertight).
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

## 2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Caps: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Furnish with 6-inch-wide joint cover plates.

1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
2. Fabricate from the following material:

- a. Aluminum: 0.050 inch (1.27 mm) thick.

- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
2. Fabricate copings from the following material:

- a. Aluminum: 0.050 inch (1.27 mm) thick.

- C. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following material:

1. Stainless Steel: 0.025 inch (0.64 mm) thick.

- D. Base Flashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

- E. Counterflashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

- F. Roof-Penetration Flashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

- G. Roof-Drain Flashing: Fabricate from the following material:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

- H. Splash Pans: Fabricate from the following material:

1. Stainless Steel: 0.025 inch thick.

## 2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing, Typical: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch-high end dams. Fabricate from the following material:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

## 2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
  1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system. Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer installation instructions, and SMACNA "Architectural Sheet Metal Manual". Anchor units work of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints and seams that will be permanently watertight and weatherproof.
  1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
  1. Coat side of stainless-steel sheet metal flashing and trim with isolation coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip-sheet or install a course of polyethylene underlayment.
  3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
  - 1. Aluminum: Use aluminum or stainless steel fasteners.
  - 2. Stainless Steel: Use stainless-steel fasteners.
- H. Seal joints with elastomeric sealant as required for watertight construction.
  - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 - JOINT SEALANTS.
- I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
  - 1. Do not solder aluminum sheet.
  - 2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
  - 3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.
- J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

### 3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions,] and SMACNA's "Architectural Sheet

Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
  - 1. Secure in a waterproof manner by means of snap-in installation and sealant.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
  - 1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

### 3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

### 3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 077100  
ROOF SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Roof-edge drainage systems.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 061000 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
  - 2. Section 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. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - a. Color and Gloss: 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 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 088000 - GLAZING for glazing sealants.
  - 2. Section 092110 - GYPSUM BOARD ASSEMBLIES for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
  - 3. Section 093000 - TILING for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
  - 4. Section 095100 - ACOUSTICAL CEILINGS for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.
- D. Qualification Data: For Installer and qualified testing agency.
- E. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- F. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.
- G. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- H. Field Test Report Log: For each elastomeric sealant application.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- D. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
    - a. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
    - b. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with joint sealant backing and glazing and gasket materials.
  2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  3. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  4. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

- E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  2. Conduct field tests for each application indicated below:
    - a. Each type of elastomeric sealant and joint substrate indicated.
    - b. Each type of nonelastomeric sealant and joint substrate indicated.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

## 1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not

comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Low-Emitting Materials: Interior sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. VOC Content: Provide interior sealants and sealant primers that comply with the following limits for VOC content:
  1. Architectural Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.
  4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.
- D. Colors of Exposed Joint Sealants: Provide colors as selected by the Architect from manufacturer's full range of standard and custom colors; maximum of five colors, three standard colors and two custom colors.

### 2.2 JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates. Provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600 or ANSI/NSF Standard 51.

- D. Exterior Silicone Sealant, Single-Component Neutral-Curing Type:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 790.
    - b. GE Silicones; SilPruf LM SCS2700.
    - c. Pecora Corporation; 864.
    - d. Tremco Inc.; Spectrem 1.
  2. Extent of Use: Exterior joints in vertical and soffit surfaces.
- E. Exterior Urethane Sealant, Multicomponent Pourable (Self-Leveling) Type for Pedestrian Traffic: ASTM C 920, Type M, Grade P, Class 25, Use T, M, & O.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Meadows, W. R., Inc.; POURTHANE.
    - b. Pecora Corporation; Urexpan NR-200.
    - c. Sika; Sikaflex-2c SL.
    - d. Tremco Inc.; THC-901.
  2. Extent of Use: Exterior joints in horizontal surfaces.
- F. Interior Sanitary Silicone Sealant, Single-Component Mildew-Resistant, Acid-Curing (Acetoxy) Type: ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, A, and O.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Bostik; Pure Silicone.
    - b. Dow Corning Corporation; 786 Mildew Resistant.
    - c. GE Silicones; Sanitary SCS1700.
    - d. Pecora; 898NST.
    - e. Sika; Sikasil GP.
    - f. Tremco; Tremsil 200.
  2. Extent of Use: Interior sanitary joints at toilet rooms, kitchens, and other wet areas.
- G. Interior 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. Available Products: Armacell Canada Inc.; ITP Standard Backer Rod; or approved equal.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate

capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry, unglazed surfaces of ceramic tile, and exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following metal, glass, porcelain enamel, and glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

#### A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
  - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
  - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
  - a. Whether sealants filled joint cavities and are free of voids.
  - b. Whether sealant dimensions and configurations comply with specified requirements.
  - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

#### B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

#### A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081110

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Standard hollow-metal steel doors and frames.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 087100 - DOOR HARDWARE for door hardware for steel doors.
  - 2. Section 088000 - GLAZING for glazed lites.
  - 3. Section 092110 - GYPSUM BOARD ASSEMBLIES for insulation.
  - 4. Section 099000 - PAINTING AND COATING for field painting steel doors and frames.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, temperature-rise ratings, and finishes for each type of steel door and frame specified.
- B. Shop Drawings:
  - 1. Elevations of each door design.
  - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- D. Qualification Data: For Installer.

- E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
  - 2. Temperature-Rise Limit: Fire door assemblies in interior exit stairways and ramps and exit passageways shall have a maximum transmitted temperature rise of not more than 450 degrees F (250 degrees C) above ambient at the end of 30 minutes of standard fire test exposure. Exception: The maximum transmitted temperature rise is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with IBC Section 903.3.1.1 or 903.3.1.2.
- D. Fire-Rated, Borrowed-Light Assemblies (Including Sidelights and Transoms): Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.
  - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ceco Door Products; an ASSA ABLOY Group Company.
  - 2. CURRIES Company; an ASSA ABLOY Group Company.
  - 3. de LaFontaine
  - 4. Philipp Manufacturing Company.
  - 5. Steelcraft; an Allegion (formerly Ingersoll-Rand) company.

### 2.2 MATERIALS

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated, (Galvanized/Galvannealed) Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60/A60 metallic coating.
- E. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- H. Insulation: Comply with requirements in Section 092110 - GYPSUM BOARD ASSEMBLIES.
- I. Glazing: Comply with requirements in Section 088000 - GLAZING.
- J. Environmental Product Declarations (EPD): Product-specific Type III EPDs for hollow metal doors and frames are available from manufacturers listed herein.

- K. Low-Emitting Materials: Provide building products in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
  - 1. Design: Flush panel.
  - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
    - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
    - b. Thermal-Rated (Insulated) Exterior Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 2.5 when tested according to ASTM C 1363.
  - 3. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick end closures or channels of same material as face sheets.
  - 4. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated (galvanized/galvannealed) steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
  - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
  - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated (galvanized/galvannealed) steel sheet.
  - 1. Fabricate frames with full profile welded joints.
  - 2. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet.

- C. Interior Frames: Fabricated from cold-rolled steel sheet.
  - 1. Fabricate frames with full profile welded joints.
  - 2. Frames for Level 2 Steel Doors: 0.053-inch-thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
  - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

## 2.6 HOLLOW METAL PANELS

- A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

## 2.7 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

## 2.8 LOUVERS

- A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
  - 1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.

2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.

## 2.9 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.

## 2.10 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
  1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  2. Glazed Lites: Factory cut openings in doors.
  3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  1. Full Profile Welded Frames: Weld joints continuously; grind, fill, dress, and make smooth, flush, and not visible.
  2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as doorframe. Fasten members at crossings and to jambs by butt welding.
  3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Two anchors per jamb up to 60 inches high.
      - 2) Three anchors per jamb from 60 to 90 inches high.
      - 3) Four anchors per jamb from 90 to 120 inches high.
      - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

- b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - 1) Three anchors per jamb up to 60 inches high.
    - 2) Four anchors per jamb from 60 to 90 inches high.
    - 3) Five anchors per jamb from 90 to 96 inches high.
    - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
    - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
  - c. Compression Type: Not less than two anchors in each jamb.
  - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
  - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 087100 - DOOR HARDWARE.
- 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
  - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 - ELECTRICAL.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
- 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings, so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 4. Provide loose stops and moldings on inside of hollow metal work.
  - 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
- 2.11 STEEL FINISHES
- A. Prime Finish: Apply manufacturer's standard epoxy primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
2. Refer to Section 099000 – PAINTING AND COATING for field-applied coating.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

#### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
  1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-protection-rated openings, install frames according to NFPA 80.

- b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable glazing stops located on secure side of opening.
    - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Metal-Stud Partitions: Solidly pack insulation behind frames.
  4. Masonry Walls: Coordinate installation of frames to allow for filling space between frames and masonry with insulation.
  5. Concrete Walls: Solidly fill space between frames and concrete with insulation.
  6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
  9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
  1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors according to NFPA 105.

- D. Glazing: Comply with hollow metal manufacturer's written instructions.
  - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

#### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- C. Metallic-Coated (Galvanized/Galvannealed) Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 081400  
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Solid-core flush wood doors for opaque finishes.
  2. Factory finishing for wood doors with opaque finish.
  3. Factory fitting flush wood doors to frames and factory machining for hardware.
  4. Louvers and glass lites for flush wood doors.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 087100 - DOOR HARDWARE for hardware for wood doors.
  2. Section 088000 - GLAZING for glass and glazing requirements.

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 SUSTAINABLE DESIGN PERFORMANCE REQUIREMENTS

- 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."
  - 1. Salvaged and reclaimed wood is excluded from certified wood requirements.
- B. Low-Emitting Materials: Provide wood doors 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."

### 2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. 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.

### 2.3 DOOR CONSTRUCTION, GENERAL

- A. 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 Finish: Manufacturer's standard water-based low VOC finish.

## 2.4 SOLID-CORE DOORS

### A. Cores: Comply with the following requirements:

1. Composite Wood, General: CARB II compliant or made with binder containing no added formaldehyde (NAF).
2. Particle Core: ANSI A 208.1, Grade 1-LD-2.
3. Agrifiber Core: ANSI A 208.1, Grade 1-LD-2.
4. Structural Composite Lumber Core: WDMA I.S.10, Timberstrand LSL.
5. Provide doors with structural composite lumber core 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.

## 2.5 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.

## 2.6 GLAZING SYSTEMS

- A. Glazing: Provide factory installed glass products in accordance with requirements in Section 088000 - GLAZING.

## 2.7 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.

## 2.8 FACTORY FINISHING

- A. Doors for Opaque Finish: Factory finish doors. Finish faces and edges of doors, including cutouts.
- B. Transparent Finish:
  1. Grade: Premium.
  2. Finish: AWS System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
  3. Color: As selected by Architect from manufacturer's full range.
  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 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 083513

GLAZED FOLDING DOORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Thermally broken aluminum-framed folding glass wall system.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 055000 - METAL FABRICATIONS for miscellaneous steel supports and framing.
  - 2. Section 087100 - DOOR HARDWARE for lock cylinders and keying.
  - 3. Section 061000 - ROUGH CARPENTRY for blocking and supports.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for folding doors.
- B. Shop Drawings: For folding doors. Include plans, elevations, sections, details, attachments to other work, clearances required for operation, and accessory items. Show blocking.
- C. Setting Drawings: For anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete and masonry, and for cutouts required in other work, including support-beam punching template.
- D. Samples for Verification: For each type of folding door indicated and for each type of exposed finish required, in manufacturer's standard sizes.
- E. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication

## PART 2 - PRODUCTS

## PART 3 - PRODUCTS

### 3.1 THERMALLY BROKEN ALUMINUM-FRAMED FOLDING GLASS WALL SYSTEMS

#### A. Basis-of-Design: Model SL70 by Nana Wall or equal by Solar Innovations or LaCantina.

1. Swing Panel - Operation / Cycling Performance (AAMA 920): 500,000 cycles.
2. System - Life Cycle Performance (DIN EN 1191/12400): 20,000 cycles.
3. Folding Glass Storefront Units tested to AAMA/WDMA/CSA 101/I.S.2/A440.
4. Forced Entry (AAMA 1304 / ATSM F842): Meets requirements for plus F1.
5. Adjustment: Folding and sliding hardware capable of compensation and adjustment without removing panels from tracks. Width Adjustment: 1/16 inch (1.5 mm) per hinge. Height Adjustment: 1/16 inch (1.5 mm) up and down.
6. Hinges: Stainless steel. Stainless steel security hinge pins and set-screws.
7. Fasteners: Tapered pins or stainless screws for connecting frame components.
8. Aluminum Extrusion: AlMgSi0.5 alloy, 6063-T5. Thickness: 0.078 inch (2.0 mm) nominal. Thermally broken with a 3/4 to 15/16 inch (20 to 24 mm) wide polyamide plastic reinforced with glass fibers.
9. Aluminum Finish Powder Coating: AAMA 2605, PVDF Kynar finish, standard color as selected.
10. Sliding and Folding System:
  - a. Manufacturer's combination sliding and folding hardware with top, bottom tracks and threshold.
  - b. Running carriages to have sealed, self-lubricating, ball bearing multi-rollers.
  - c. Surface mounted hinges and running carriages will not be allowed.
  - d. Weight of panels supported by the bottom of the track will not be allowed.
11. Mounting: Upper guide carriage and lower running carriage with four vertical stainless steel wheels and two horizontal polyamide plastic wheels. The vertical wheels to ride on top of sill track and lie above the water run-off level. Carrying capacity of lower running carriage to be 440 lbs (200 kg).
12. Aluminum Thresholds: Thermally broken with polyamide, raised sill. Finish to match panel finish.
13. Glazing: 15/16 inch tempered insulating glass units, low-e coating, spacers to match frame, selected from manufacturer's standard spacer colors. Source from same source as storefront glazing.

## PART 4 - EXECUTION

### 4.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of folding doors.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 4.2 PREPARATION

- A. For folding doors supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings showing locations of anchorage devices and similar items.

#### 4.3 INSTALLATION

- A. Install frame in accordance with manufacturer's recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.
- B. Securely attach anchorage devices to rigidly fit frame in place, level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
- C. When lower track is designed to drain, provide connections to allow for drainage.
- D. Install panels, handles, lockset and accessories in accordance with manufacturer's recommendations and instructions.

#### 4.4 ADJUSTING

- A. Adjust units as necessary to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.

END OF SECTION

## SECTION 084110

### ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

#### PART 1 - GENERAL

##### 1.1 GENERAL PROVISIONS

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

##### 1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Exterior and interior aluminum-framed storefronts.
  2. Exterior and interior manual-swing aluminum doors.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 079200 - JOINT SEALANTS for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
  2. Section 087100 - DOOR HARDWARE for lock cylinders and keying.
  3. Section 088000 - GLAZING for glazing requirements to the extent not specified in this Section.
  4. Section 089000 - LOUVERS AND VENTS for units installed with aluminum-framed systems.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design entrance and storefront system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
1. Structural loads.
  2. Thermal movements.
  3. Dimensional tolerances of building frame and other adjacent construction.
  4. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferred to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
    - d. Noise or vibration created by wind and thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Sealant failure.

- g. Failure of operating units to function properly.
- C. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.
- D. Deflection of Framing Members:
  - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch and clearance between members and operable units directly below to less than 1/16 inch.
- E. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. Air Infiltration: Provide doors and storefront which comply with the following. Test unit in accordance with ASTM E 283.
  - 1. Swinging Entrance Doors, ASHRAE Requirement: 1.0 cfm/sf maximum air leakage at a pressure differential of 1.57 psf.
  - 2. Storefront, ASHRAE Requirement: 0.06 cfm/sf maximum air leakage at a pressure differential of 1.57 psf or higher.
- G. Water Leakage Test: Test fixed framing system in accordance with ASTM E 331.
  - 1. Test Pressure: 8 psf.
  - 2. Performance: No leakage as defined in test method at specified test pressure. No uncontrolled water penetrating system or appearing on normally exposed interior surfaces.
- H. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.
- I. Thermal Transmittance: Provide window units that have a U-value as required by Code rated in BTU/hour/sq. ft./degrees F at 15-mph exterior wind velocity, when tested in accordance with AAMA 1503.1. Test unit to be 4 ft. x 6 ft. Submit proof of compliance with submittals as specified.
- J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 65 for fixed storefront units and not less than 55 for doors when tested according to AAMA 1503.

#### 1.4 SUBMITTALS

- A. **Product Data:** Include installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated. Indicate special procedures and perimeter conditions requiring special attention.
- B. **Shop Drawings:** Prepared under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum-framed systems. For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.
  - 3. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
  - 4. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
  - 5. Wiring diagrams for power, signal, and control wiring.
  - 6. Activation and safety devices.
  - 7. Include full-size isometric details of each vertical-to-horizontal intersection of storefronts, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions
    - d. Glazing
    - e. Flashing and drainage.
  - 8. Include details showing interface with perimeter conditions to depict interface with adjacent thermal, weather, air and vapor barriers, and adjacent flashings.
  - 9. Shop drawings must be signed and stamped by a professional engineer.
- C. **Delegated-Design Submittal:** For entrance and storefront systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Show structural testing for attachment of the storefront to the existing structure. Contractor should survey slab edge locations and conditions of the embeds to develop the attachment details.
- D. **Samples for Verification:** For each type of exposed finish required, in manufacturer's standard sizes.
- E. **Qualification Data:** For Installer.
- F. **Product Test Reports:** Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.
- G. **Performance Reports:** Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:
  - 1. U-value.
  - 2. Solar heat-gain coefficient.

- H. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of entrance and storefront systems that are similar to those indicated for this Project in material, design, and extent.
- C. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
- D. Accessible Entrances: Comply with authorities having jurisdiction, local state building code and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- E. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to storefront system, including, but not limited to, the following:
  - 1. Review structural load limitations.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review required testing, inspection, and certifying procedures.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

#### 1.7 WARRANTY

- A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
  - b. Faulty operation of operators, controls, and hardware.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Storefront, Thermal Break, 2 inch by 4-1/2 inch profile:
    - a. EFCO Corporation, 403X.
    - b. Kawneer North America, 451UT.
    - c. Oldcastle BuildingEnvelope, 3000XT.
    - d. Tubelite Inc., TU24000.
    - e. YKK AP America Inc., YES 45 XT.
  2. 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.
  3. Doors, Medium Stile:
    - a. EFCO Corporation, D-300.
    - b. Kawneer North America, 350.
    - c. Oldcastle BuildingEnvelope, MS-375.
    - d. Tubelite Inc., Medium.
    - e. YKK AP America Inc., 35D.
  4. Doors, Medium Stile, Thermally-Broken:
    - a. EFCO Corporation, D-302.
    - b. Kawneer North America, Insulpour 350T.
    - c. Oldcastle BuildingEnvelope, MS-375TC.
    - d. Tubelite Inc., Medium Thermal Block.
    - e. YKK AP America Inc., 35XT.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Dual thermal-break.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

## 2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 - GLAZING.

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

## 2.5 DOORS

- A. Doors: Manufacturer's standard glazed doors, for manual swing operation.
  - 1. Door Construction: Mechanical clip fastening, SIGMA deep penetration plus welds and 1-1/8 inch long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type and EPDM glazing gaskets reinforced with non-stretchable cord.

## 2.6 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.
  - 1. Opening-Force Requirements:
    - a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf.
- B. Pivot Hinges: BHMA A156.4, Grade 1.
- C. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation.
  - 1. Opening-Force Requirements:
    - a. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
    - b. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.
- D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- E. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
  - 1. Standard: BHMA A156.3, Grade 1.
- F. Cylinders: As specified in Section 087100 - DOOR HARDWARE.
- G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- H. Operating Trim: BHMA A156.6.
- I. Closers: With accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use, and adjustable to meet field conditions and requirements for opening force.
  - 1. Standard: BHMA A156.4, Grade 1.
- J. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- K. Surface-Mounted Holders: BHMA A156.16, Grade 1.

- L. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- M. Weather Stripping: Manufacturer's standard replaceable components.
  - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
- N. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- O. Silencers: BHMA A156.16, Grade 1.
- P. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
  - 1. Standard: BHMA A156.21.
- Q. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

## 2.7 ACCESSORY MATERIALS

- A. Insulating Materials: As specified in Section 072100 - THERMAL INSULATION.
- B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 - JOINT SEALANTS.
- C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.8 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

- E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
  - 1. At exterior doors, provide compression weather stripping at fixed stops.
  - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- F. Doors: Reinforce doors as required for installing hardware.
  - 1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
  - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.9 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 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 085200

WOOD WINDOWS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Fixed and operable aluminum-clad wood-framed windows with factory-installed glass and glazing, and with primed wood interior finish.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 088000 - GLAZING for glazing requirements for wood windows, except those specified to be factory glazed.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide wood 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 wood windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.
  - 1. Performance Class: C - Commercial.
  - 2. Performance Grade: Minimum for performance class indicated.
  - 3. Exception to AAMA/NWWDA 101/I.S.2: In addition to requirements for performance class and performance grade, design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on Code requirements.
- C. Structural Performance: Provide wood 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:
  - 1. Deflection: Based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Deflection Test.
  - 2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on structural computations.

3. Wind Speed: As required by Code.
  - 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. Thermal Transmittance: Provide wood 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.
  - G. Solar Heat-Gain Coefficient: Provide wood 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.
- 1.4 SUBMITTALS
- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of wood window indicated.
  - B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:
    1. Mullion details, including reinforcement and stiffeners.
    2. Joinery details.
    3. Expansion provisions.
    4. Flashing and drainage details.
    5. Weather-stripping details.
    6. Glazing details.
    7. Window cleaning provisions.
    8. 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: For wood window components required, prepared on Samples of size indicated below.
    1. Main Framing Member: 12-inch-long, full-size sections of extrusions with factory-applied color finish.
    2. Hardware: Full-size units with factory-applied finish.
    3. Weather Stripping: 12-inch-long sections.

- D. Qualification Data: For Installer and professional engineer.
- E. 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 wood window. Test results based on use of downsized test units will not be accepted.
- F. 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 wood window manufacturer for installation of units required for this Project.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain wood windows through one source from a single manufacturer.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for wood 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.
- E. 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 wood windows with an attached label.
- F. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify wood 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 wood 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 wood 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: Two 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. Aluminum-Clad Wood Windows:
    - a. Eagle Window & Door, Inc.
    - b. Kolbe & Kolbe Millwork Co., Inc.
    - c. Marvin Windows and Doors.
- B. Basis-of-Design: Marvin Windows and Doors.

### 2.2 MATERIALS

- A. Wood: Clear ponderosa pine or another suitable fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.
- B. Aluminum Extrusions and Rolled Aluminum for Cladding: Manufacturer's standard formed sheet or extruded-aluminum cladding, mechanically bonded to exterior exposed wood members. Provide aluminum alloy and temper recommended by wood window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, and not less than 16,000-psi minimum yield strength.
1. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight and complying with AAMA 2605.
    - a. Available Products: Sherwin-Williams Coil Coatings; Valspar Fluropon Pure; or approved equal.
    - b. Building Product Disclosure and Optimization, Material Ingredients: Declare product label.
    - c. Color and Gloss: As selected by Architect from manufacturer's full range.
- C. Wood Trim and Glazing Stops: Material and finish to match frame members.

- D. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood window members, cladding, trim, hardware, anchors, and other components.
  - 1. 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.
- E. 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.
- F. Reinforcing Members: Aluminum, or 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.
- G. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when wood window is closed.
  - 1. Weather-Stripping Material: Elastomeric cellular preformed gaskets complying with ASTM C 509.
- H. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
  - 1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
- I. Replaceable Weather Seals: Comply with AAMA 701/702.

## 2.3 GLAZING

- A. Insulating-Glass Units for Vertical Glazing: Minimum 3/4 inch thick insulating glass consisting of two equal lites with low-e coating on No. 2 surface and argon gas filled. Thickness sufficient to maintain DP rating on the window for each window size on the project.
- B. General: Comply with AAMA/NWWDA 101/I.S. 2.

## 2.4 INSECT SCREENS

- A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Provide for each operable exterior sash or ventilator.
- B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
  - 1. Aluminum Tubular Framing Sections and Cross Braces: Roll-formed from aluminum sheet with minimum wall thickness as required for class indicated.
  - 2. Finish: Baked-on organic coating in color selected by Designer from manufacturer's full range.

- C. Glass-Fiber Mesh Fabric: Manufacturer's standard mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration in the following color. Comply with ASTM D 3656.
- D. Wickets: Not allowed.

## 2.5 ACCESSORIES

- A. Grids: Removable grids and simulated divided lites as indicated on the Drawings. Color as selected by Architect.

## 2.6 FABRICATION

- A. General: Fabricate wood 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. Exterior Cladding: Minimum thickness 0.050 inch.
- C. Reglazing: Fabricate wood windows that are reglazable without dismantling sash or ventilator framing.
- D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator, unless otherwise indicated.
  - 1. Double-Hung Windows: Provide weather stripping only at horizontal rails of operable sash.
- E. Factory machine windows for openings and hardware that is not surface applied.
- F. 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.
- G. Factory-Glazed Fabrication: Except for light sizes in excess of 100 unites inches, glaze wood windows in the factory where practical and possible for applications indicated. Comply with AAMA/NWWDA 101/I.S.2.
- H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

## 2.7 WOOD FINISHES

- A. Factory-Finished Windows: Provide fabricator's standard factory finish consisting of prime coat applied to interior wood surfaces.

## 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; 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. 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 ADJUSTING

- A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

### 3.4 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 exposed 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 088000

GLAZING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

- 1. Glass and glazing for the following products and applications:

- a. Steel doors, frames and sidelights specified in Section 081110 - HOLLOW METAL DOORS AND FRAMES.
- b. Glazed entrances and storefronts specified in Section 084110 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- c. Interior lites.
- d. Unframed mirrors.

- 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 083513 - GLAZED FOLDING DOORS for factory glazing.
- 3. Section 085200 - WOOD 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. 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.
- H. 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."

- I. 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.

- J. 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.

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

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

- 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

#### 1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

- 1. Warranty Period: Ten years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to the Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

- 1. Warranty Period: Five years from date of Substantial Completion.

- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to the Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 INSULATING-GLASS UNITS

- A. Insulating-Glass Units for Vertical Glazing: 1 inch thick (25.0 mm) insulating glass consisting of two lites of 1/4 inch (6 mm) glass, low e coating on the No. 2 surface and argon gas filled. Provide one of the following or equal:

1. Guardian Industries; SN-68.
  - a. Visible Light Transmittance: 68 percent.
  - b. Reflectance Visible Light: 10 percent.
  - c. U Value (Winter): 0.25.
  - d. Shading Coefficient: 0.43.
  - e. Solar Heat Gain Coefficient: 0.38.
2. Viracon; VE1-2M.
  - a. Visible Light Transmittance: 70 percent.
  - b. Reflectance Visible Light: 11 percent.
  - c. U Value (Winter): 0.25.
  - d. Shading Coefficient: 0.43.
  - e. Solar Heat Gain Coefficient: 0.37.
3. Vitro Architectural Glass (formerly PPG Industries); Solarban 60.
  - a. Visible Light Transmittance: 70 percent.
  - b. Reflectance Visible Light: 11 percent.
  - c. U Value (Winter): 0.29.
  - d. Shading Coefficient: 0.44.
  - e. Solar Heat Gain Coefficient: 0.38.

### 2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
1. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
  2. For uncoated glass, comply with requirements for Condition A.
  3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- C. Coated Float Glass: Pyrolytic and vacuum deposited coatings on glass in conformance with ASTM C 1376.
- D. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.

1. Tint Color: As selected by the Architect.
  2. Visible Light Transmittance: As standard with manufacturer.
- E. Tempered Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind FT; 1/4 inch thick unless indicated otherwise.
- F. 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.
- G. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
1. Mirror Edge Treatment: Flat polished edge.

## 2.3 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Verify glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, interlayer of laminated glass, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
  4. VOC Emissions: Provide sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  5. VOC Content:
    - a. Structural Glazing Adhesives: 100 g/L.
    - b. Architectural Sealants: 250 g/L.

6. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:

- a. Dow Corning Corporation; 790.
- b. GE Silicones; SilPruf LM SCS2700.
- c. Tremco Inc.; Spectrem 1.

## 2.4 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for project conditions.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

G. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. VOC Emissions: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
2. VOC Content: 250 g/L or less.
3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
4. Do not use adhesives that contain urea formaldehyde.

- H. Mirror Hardware, Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

## 2.6 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
  1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  2. Presence and functioning of weep system.
  3. Minimum required face or edge clearances.
  4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

### 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.
- 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.
  2. Include sill, jambs, and head details showing the integration with adjacent air and water barriers.
  3. Include details of the continuous sill pan with upturned back and end dams. Note on drawings how continuity will be maintained at the sill pan corners.
- 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 FIXED, EXTRUDED-ALUMINUM LOUVERS

- 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. Industrial Louvers, Inc.

B. Horizontal Storm-Resistant Louvers:

1. Louver Depth: As indicated on the Drawings.
2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch.
3. Performance Requirements: AMCA 550.
  - 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.

C. General: Provide screen at each exterior louver. 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. Fabricate frames with mitered corners to louver sizes indicated.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening, aluminum, 1/2-inch-square mesh, 0.063-inch wire

D. 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.

## 2.2 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. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  1. Color and Gloss: As selected by Architect from manufacturer's full range.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable only if they are within the range of approved Samples, or shall not exceed  $DE^*a^*b^*$  of 2.0 from a single control sample. Noticeable variations in the same piece are not acceptable.'

## 2.3 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.

## 2.4 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. Integral sills shall include a continuous sill pan with back and end dams. Water that runs off the louver shall be collected in the sill pan and drained away from the building.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. 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.
- G. 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.

## 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 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)

PROJECT IDENTIFICATION: Orleans Community Building

SUB-BID FOR SECTION: 090002 - TILE

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: *to be inserted with final documents.*

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)

PROJECT IDENTIFICATION: Orleans Community Building

SUB-BID FOR SECTION: 090003 – ACOUSTICAL TILE

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: *to be inserted with final documents.*

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)

PROJECT IDENTIFICATION: Orleans Community Building

SUB-BID FOR SECTION: 090005 – RESILIENT FLOORS

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: *to be inserted with final documents.*

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)

PROJECT IDENTIFICATION: Orleans Community Building

SUB-BID FOR SECTION: 090007 – PAINTING

2. Each sub-bid submitted for work under this Section shall be on forms furnished by the Awarding Authority as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms may be obtained at the office of the Awarding Authority.
3. Sub-bids filed with the Awarding Authority shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the Awarding Authority in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: *to be inserted with final documents.*

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, including angles in partial-height partitions.
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 061000 - ROUGH CARPENTRY for plywood backing panels.
2. Section 061600 - SHEATHING for sheathing at exterior assemblies.
3. Section 083110 - ACCESS DOORS AND FRAMES for furnishing access doors and frames in gypsum board assemblies.
4. 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.
2. Provide metal framing engineered to meet code requirements, project requirements, required heights, and the following deflection criteria. 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 shafts.
3. Provide fire stop tracks capable of withstanding deflection within limits and under conditions 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.
4. Exception: Walls in Group R-2 occupancies that do not have a removable decorative ceiling allowing access to the concealed space.

#### 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 and project requirements. and specified deflection criteria.
- 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. 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-Steel (Uncoated) Thickness: 0.0296 inches (20 gage).
  2. Dimpled studs meeting performance values for equivalent standard studs are acceptable.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
  1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
  3. Deflection Track / Deflection Clip: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Brady Innovations; Sliptrack Systems.
      - 2) California Expanded Metals Co. (CEMCO); CST Slotted Tracks.
      - 3) Clark Dietrich Building Systems; MaxTrak Slotted Deflection Track.
      - 4) Steel Network Inc. (The); VertiTrack VT Series.
- D. Fire Stop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness compatible with studs and in width to accommodate depth of studs.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- a. California Expanded Metals Co. (CEMCO); FAS-TRK 1000 Slotted Tracks.
  - b. Clark Dietrich Building Systems; BlazeFrame Fire Stop Deflection Track.
  - c. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
  - d. GCPAT; FlameSafe FlowTrack System.
- 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 for wood framing, ICC for metal framing.
  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. Georgia-Pacific (G-P) Gypsum.
3. National Gypsum Company.
4. United States Gypsum Company (USG).

B. Gypsum Wallboard: ASTM C 1396.

1. Available Products: USG; SHEETROCK EcoSmart Panels.
2. Thickness: 1/2 inch and 5/8 inch as indicated.
3. Long Edges: Tapered.
4. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
5. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

C. Gypsum Wallboard, Fire-Resistant Type X: ASTM C 1396.

1. Available Products: USG; SHEETROCK EcoSmart Panels Firecode X.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered.
4. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
5. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
6. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
4. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
5. Building Product Disclosure and Optimization, Material Ingredients: Declare product labels.
6. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

## 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. For control joints in fire rated walls provide Cemco FAS 093X fire-rated control joint or equal.
    - 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. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  2. VOC Content: 50 g/L or less.
  3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
  4. 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.
  3. For fastening abuse-resistant gypsum panels, use Type S 'high-low' screws.
  4. For fastening impact-resistant gypsum panels, use Type S 'high-low' screws.
- 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. CertainTeed Corporation; NoiseReducer.
    - b. Johns Manville; Unfaced Formaldehyde-Free Fiber Glass Insulation.
    - c. Knauf Insulation; EcoBatt.
    - d. Owens Corning; EcoTouch SAB.
    - e. Owens Corning; Thermafiber SAFB FF.
    - f. Rockwool (formerly Roxul); AFB evo.
  2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD).
  4. Recycled Content: Use minimum recycled content of 25%.
  5. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
  6. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.
- E. Acoustical Sealant: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, joint sealant, recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Available Products, for Concealed and Exposed Joints: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
  - b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
  - c. USG; SHEETROCK Acoustical Sealant.
2. Available Products, for Concealed Joints Only: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. OSI (a division of Henkel); Pro-Series SC-175.
  - b. Pecora Corp.; BA-98.
  - c. Tremco, Inc.; Tremco Acoustical/Curtainwall Sealant.
3. Low-Emitting Materials: Provide sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. VOC Content, Architectural Sealants: 250 g/L or less.
5. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

## 2.9 IDENTIFICATION LABELS FOR FIRE- AND SMOKE-PARTITIONS

- A. Identification Labels: Self-adhesive signs, to comply with applicable local Code.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fire Wall Signs, Inc.
    - b. Marking & Identification Tape (mnitape.com).
    - c. My Safety Sign.
    - d. Safety Supply Warehouse.
  2. Text: "FIRE AND SMOKE BARRIER - PROTECT ALL OPENINGS".

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754. Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension 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: Comply with GA-214. 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; includes areas to receive dry erase coatings, wall graphics, and wallcoverings.
- 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 092409

PLASTER PATCHING AND REPAIRS

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. Patching and repair of existing plaster finishes.
- 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 new gypsum wall board and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.

1.4 QUALITY ASSURANCE

- A. Mockups: Before plastering, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Install mockups for each type of finish indicated.
  - 2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. 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.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 843 requirements or gypsum veneer plaster manufacturer's written recommendations, whichever are more stringent.
- B. Room Temperatures: Maintain not less than 55 deg F or more than 80 deg F for 7 days before application of plaster, continuously during application, and after application until plaster is dry.

## PART 2 - PRODUCTS

### 2.1 PLASTER

- 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. G-P Gypsum.
  - 2. National Gypsum Company.
  - 3. USG Corporation.

### 2.2 METAL LATH

- A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653, G60, hot-dip galvanized zinc coating.
  - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. Alabama Metal Industries Corporation; a Gibraltar Industries Company.
    - b. CEMCO, California Expanded Metal Products.
    - c. ClarkDietrich Building Systems.
  - 2. Striplath: Fabricated from expanded-metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

### 2.3 ACCESSORIES

- A. General: Coordinate depth of trim and accessories with thicknesses and number of plaster coats required. Provide materials that comply with referenced product standards and manufacturer's written recommendations.
- B. Standard Trim: ASTM C 1047, provided or approved by manufacturer for use in plaster applications indicated.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  - 2. Shapes: To match existing and as approved by the Architect.
- C. Bonding Agent or Compound: ASTM C 631.
- D. 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.

- E. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter, unless otherwise indicated.
- F. Joint Reinforcing Materials and Tapes: Comply with joint strength requirements in ASTM C 587 and with plaster manufacturer's written recommendations for each application indicated.

#### 2.4 PLASTER MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
- B. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- C. Sand Aggregate: ASTM C 897 or ASTM C 35.
- D. Water: Potable, clean and free from deleterious amount of oils, salts, alkali, organic matter, and other harmful materials.

#### 2.5 PLASTER MIXES

- A. General: Mechanically mix plaster materials to comply with ASTM C 842 and ASTM C 843 and with plaster manufacturer's written recommendations.
- B. Factory-Prepared Finish-Coat Plaster Mixes: For factory-prepared finish coatings, comply with manufacturer's written instructions. Mix to match existing for each coat.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Cut back existing damaged plaster and lath as required. Attach new strapping to existing substrates as required.

#### 3.3 INSTALLING METAL LATH

- A. Expanded-Metal Lath: Install according to ASTM C 841 or ASTM C 1063.

#### 3.4 INSTALLING ACCESSORIES

- A. Install according to ASTM C 841 and ASTM C 1063 and at locations indicated on Drawings.
- B. Control Joints: Install control joints in specific locations, as approved by Architect, and as follows:

1. To match existing control joints.
2. For visual effect.
3. To prevent future plaster failures.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

### 3.5 PLASTER APPLICATION

- A. General: Comply with ASTM C 842.
  1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.
- B. Factory-Prepared Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- C. Finish Texture: Match existing, per approved mock-ups.

### 3.6 PLASTER REPAIRS

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

### 3.7 PROTECTION

- A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

SECTION 093000

TILING

(Part of Work of Section 090002 - TILE, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Floor, wall, and base tiles.
  - 2. 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 033000 - CAST-IN-PLACE CONCRETE for monolithic slab finishes specified for tile substrates.
  - 2. Section 079200 - JOINT SEALANTS for sealing of joints between dissimilar materials.
  - 3. Section 083110 - ACCESS DOORS AND FRAMES for installation in tile.
  - 4. 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 PERFORMANCE REQUIREMENTS

- A. Wet Dynamic Coefficient of Friction: For flooring exposed as a walking surface, provide products with the following values as determined by testing identical products per ANSI/ NFSI B101.3 - 2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials, or ANSI 326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials - 2017. Testing by other methods or earlier editions of the specified test method is not acceptable.
  - 1. Wet Dynamic Coefficient of Friction: Not less than 0.43.

1.5 SUBMITTALS

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

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. Stone Thresholds: 6-inch lengths.

4. Metal Edge Strips: 6-inch lengths.

D. Qualification Data: For Installer.

E. Material Test Reports: For each tile setting product.

## 1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting Materials: Obtain ingredients of a uniform quality for each membrane, mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

1. Stone thresholds.

2. Metal edge strips.

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

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid additives in unopened containers and protected from freezing.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

## 1.9 WARRANTY

- A. Tiling Contractor's Warranty: The tiling subcontractor shall supply Owner with a minimum two-year workmanship warranty for each tile area. In the event any work related to the tiling and setting materials is found to be defective within two years of substantial completion, the tiling contractor shall remove and replace such at no additional cost to the Owner. The tiling subcontractor's warranty obligation shall run directly to the Owner, and a copy the tiling signed warranty shall be sent to the tiling system's manufacturer.

- 1. The duration of the tiling subcontractor's two-year warranty shall run concurrent with the tiling system's manufacturer's 25-year warranty.

- B. Tiling Systems Manufacturer's Warranty: The tiling systems manufacturer shall guarantee installed tile areas to be in a fully bonded, uncracked, flat, and watertight condition, for a period of 25 years, from the date of final acceptance of the tiling system. The warranty shall be a 25-year no dollar limit (NDL), non-prorated total system labor and material warranty. Total system warranty shall include tiling materials, related components and accessories including, but not limited to the substrate board, waterproofing and crack suppression membranes, mortars, grouts, adhesives, transition materials, and floor drain assemblies.

## PART 2 - PRODUCTS

### 2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

### 2.2 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.
  - 3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD for ceramic tiles.

- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

### 2.3 TILE PRODUCTS

- A. 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.

- B. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
- C. 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.

#### 2.4 THRESHOLDS AND EDGE STRIPS

- A. Thresholds: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
  - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
  - 1. Description: Uniform, fine- to medium-grained white stone with gray veining.
- C. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and resilient base, designed specifically for flooring applications.
  - 1. Basis of Design: Schluter Systems.
  - 2. Material: ASTM B 221, extruded aluminum, with clear anodized satin finish.

#### 2.5 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. Waterproof Membrane: Manufacturer's standard product, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- D. Fabric-Reinforced, Fluid-Applied Waterproofing and Crack Suppression Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
  - 1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.

- b. Laticrete; Hydro Ban.
    - c. MAPEI; Mapelastic AquaDefense.
  - 2. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
  - 3. Low-Emitting Materials, General Emissions Evaluation: Provide membranes in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - a. VOC Content, Waterproofing Sealer: 100 g/L or less.
    - b. GreenGuard Gold certification.
- E. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
  - 1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
  - 2. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD for mortar.
- F. 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.
  - 3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD for mortar.
- G. Tile Grout, Cementitious Type: ANSI A118.7, liquid-latex form for addition to prepackaged dry-grout mix.
  - 1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Custom Building Products; Polyblend.
    - b. Laticrete; Permacolor Select.
    - c. MAPEI; Keracolor.
  - 2. Cementitious Grout Types:
    - a. Unsanded grout mixture for joints 1/8 inch and narrower.
    - b. Sanded grout mixture for joints 1/8 inch and wider.
  - 3. Color: To be selected by Architect from manufacturer's full range.
  - 4. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD for grout.
  - 5. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
  - 6. Low-Emitting Materials, General Emissions Evaluation: Provide membranes in compliance with the requirements of the California Department of Public Health's

"Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- a. VOC Content, Ceramic Tile Adhesives: 65 g/L or less.
  - b. GreenGuard Gold certification.
- H. 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.
  - 3. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
  - 4. Low-Emitting Materials, General Emissions Evaluation: Provide membranes in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - a. VOC Content, Ceramic Tile Adhesives: 65 g/L or less.
    - b. GreenGuard Gold certification.
- I. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- J. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

## 2.6 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.

## 2.7 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. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
    - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in mortar (thinset).
    - 2. Do not extend membranes under thresholds set in mortar. Fill joints between such thresholds and adjoining tile set on membrane with elastomeric sealant.
  - I. 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.
  - J. Floor Sealer: Apply floor sealer to grout joints according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- 3.4 MEMBRANE INSTALLATION
- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
  - B. Install crack-suppression membrane to comply ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
  - C. Do not install tile over membrane until membrane has cured and been tested to determine that it is watertight.
- 3.5 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.

### 3.6 TILE INSTALLATION SCHEDULE

- A. This schedule refers to Tile Installation Methods specified in the TCNA Manual.
- B. Floor Tile Over Concrete, Typical: TCNA F113 and ANSI A108.5.
1. Tile Type: Refer to Finish Schedule.
  2. Mortar: Thinset.
  3. Grout: Polymer-modified unsanded grout.
  4. Joint Width: 1/16 inch.
- C. Floor Tile Over Waterproof Membrane and Concrete, at Toilet Rooms: TCNA F122 and ANSI A108.5.
1. Tile Type: Refer to Finish Schedule.
  2. Mortar: Thinset.
  3. Grout: Polymer-modified unsanded grout.
  4. Joint Width: 1/16 inch.
- D. 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.
3. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
3. Identify materials with appropriate markings of applicable testing and inspecting agency.
4. Surface-Burning Characteristics: Provide acoustical panels complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

C. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

#### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## 1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

### 2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong Ceilings.
  - 2. CertainTeed Ceilings.
  - 3. USG.

### 2.3 METAL SUSPENSION SYSTEMS

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  - 3. Face Design: Flat, flush.
  - 4. Cap Material: Steel or aluminum cold-rolled sheet.
  - 5. Color: White, prefinished.
  - 6. Grid Face Width: As specified with ACT type.
  - 7. Recycled Content: Use minimum recycled content of 25%.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
  - 1. Anchors in Concrete: Anchors with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency; zinc-plated for Class SC1 service.
    - a. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or

other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
    - a. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 diameter wire.
- D. Hold-Down Clips: At vestibules and areas subject to wind uplift, provide manufacturer's standard hold-down clips spaced 24 inches on all cross tees.

## 2.4 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
  2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
  3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.
- B. Suspension Trim: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.; Axiom.
  2. CertainTeed Ceilings; Approved equal.
  3. USG Interiors, Inc.; Compasso.

## 2.5 ACOUSTICAL SEALANT

- A. Acoustical Sealant, for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, joint sealant, recommended for sealing interior concealed joints to reduce airborne sound transmission.
1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. OSI (a division of Henkel); Pro-Series SC-175.
    - b. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
    - c. Pecora Corp.; BA-98.
    - d. Specified Technologies, Inc. (STI); Smoke N Sound Acoustical Sealant.
    - e. USG; SHEETROCK Acoustical Sealant.

2. Low-Emitting Materials: Provide adhesives and sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. VOC Content, Architectural Sealants: 250 g/L or less.
4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
  4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  6. Do not attach hangers to steel deck tabs.
  7. Space hangers not more than 48 o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
  - 1. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  - 2. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

#### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096510

RESILIENT FLOORING AND ACCESSORIES

(Part 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. Resilient flooring.
  - 2. Resilient wall base and accessories.
  - 3. Resilient stair accessories.
  - 4. Substrate preparation for resilient flooring and accessories.
  - 5. High-performance adhesive suitable for RH and pH measured in substrate.

1.3 PERFORMANCE REQUIREMENTS

- A. Wet Dynamic Coefficient of Friction: For flooring exposed as a walking surface, provide products with the following values as determined by testing identical products per ANSI/ NFSI B101.3 - 2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials, or ANSI 326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials - 2017. Testing by other methods or earlier editions of the specified test method is not acceptable.
  - 1. Wet Dynamic Coefficient of Friction: Not less than 0.43.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 1. Show details of special patterns.
- C. Samples for Verification: Full-size units of each color and pattern of resilient flooring required.
  - 1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.
  - 2. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

- D. Seam Samples for Sheet Flooring: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch. Sample applied to a rigid backing and prepared by Installer for this Project.
- E. Maintenance Data: For resilient products to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

#### 1.7 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

### PART 2 - PRODUCTS

#### 2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

#### 2.2 LUXURY VINYL TILE FLOOR COVERING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Congoleum Corporation.
  - 3. Mannington Mills, Inc.
  - 4. Tarkett, Inc.

- B. Luxury Vinyl Tile Floor Covering: ASTM F 1700.
  - 1. Thickness: 0.080 inch.
  - 2. Size: 18 by 18 inches.
  - 3. Style and Colors: As indicated on the Finish Schedule.

### 2.3 RESILIENT WALL BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. American Biltrite Flooring; AB Pure.
  - 2. Johnsonite, a division of Tarkett.
  - 3. Nora Systems, Inc.
- B. Resilient Wall Base: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous). Do not use polyvinyl chloride (PVC).
  - 1. Shape: Straight (toeless) at carpet and coved at concrete and resilient flooring.
  - 2. Minimum Thickness: 0.125 inch.
  - 3. Height: 4 inches.
  - 4. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
  - 5. Outside Corners: Premolded.
  - 6. Inside Corners: Premolded.
  - 7. Surface: Smooth.
  - 8. Style and Colors: As indicated on the Finish Schedule.
  - 9. Material Ingredients: Cradle to Cradle (C2C) certification or Declare product label. PVC, phthalate-, chlorine-, and halogen-free.
  - 10. Low-Emitting Materials: FloorScore certification.

### 2.4 RESILIENT MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. American Biltrite Flooring; AB Pure.
  - 2. Johnsonite, a division of Tarkett.
  - 3. Nora Systems, Inc.
- B. Types Include the Following as Applicable: Cap for cove carpet, cap for cove resilient sheet floor covering, carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet.
  - 1. Material: Rubber.
  - 2. Profile and Dimensions: As indicated.

### 2.5 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.
  - 1. Available Products: Mapei; Mapecem Premix.

- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - a. VOC Content: 50 g/L or less.
    - b. Methylene chloride and perchloroethylene may not be intentionally added to adhesives. Do not use adhesives that contain urea formaldehyde.
  - 2. Adhesives, for Wall Base:
    - a. Available Products: Subject to compliance with requirements, provide one of the following products:
      - 1) Forbo; L910W Wall Adhesive.
      - 2) Johnsonite; 960 Cove Base Adhesive.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within a range on pH scale not less than 5 or more than 9 pH, or as otherwise required in writing by manufacturer of flooring.
  - 3. Moisture Vapor Emission Testing:
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, or as otherwise required in writing by manufacturer of flooring.

4. Relative Humidity Testing:
  - a. Perform relative humidity test, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level of 75 percent, or as otherwise required in writing by manufacturer of flooring.
5. Perform tests indicated above and as recommended by flooring manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- 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 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. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
  - 2. 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 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. Allowances: Refer to Drawings and Section 012100 - ALLOWANCES for requirements.
- C. Alternates: Refer to Drawings and Section 012300 - ALTERNATES for requirements.
- D. 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 055150 - METAL RAILINGS for shop priming ferrous metal.
  4. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for shop priming interior architectural woodwork.
  5. Section 081110 - HOLLOW METAL DOORS AND FRAMES for factory priming steel doors and frames.
  6. Section 081400 - FLUSH WOOD DOORS for factory finishing.
  7. Section 092110 - GYPSUM BOARD ASSEMBLIES for surface preparation of gypsum board.

1.3 DEFINITIONS AND EXTENT

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
  2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
  3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.
- B. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
  1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
  1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- D. Do NOT paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
  1. Prefinished items include the following factory-finished components:
    - a. Architectural woodwork.
    - b. Acoustical wall panels.
    - c. Toilet enclosures.
    - d. Metal lockers.
    - e. Kitchen appliances.
    - f. Elevator entrance doors and frames.
    - g. Elevator equipment.
    - h. Finished mechanical and electrical equipment.
    - i. Light fixtures.
  2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    - a. Foundation spaces.
    - b. Furred areas.
    - c. Ceiling plenums.
    - d. Utility tunnels.
    - e. Pipe spaces.
    - f. Duct shafts.
    - g. Elevator shafts.
  3. Finished metal surfaces include the following:
    - a. Anodized aluminum.
    - b. Stainless steel.
    - c. Chromium plate.
    - d. Copper and copper alloys.
    - e. Bronze and brass.
  4. Operating parts include moving parts of operating equipment and the following:

- a. Valve and damper operators.
  - b. Linkages.
  - c. Sensing devices.
  - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

#### 1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
    - a. Disclose material ingredients by name and Chemical Abstract Service (CAS) Registry Number.
  2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
  2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
  3. Submit two 8 inch by 12 inch Samples for each type of finish coating for Architect's review of color and texture only.
- C. Qualification Data: For Applicator.

#### 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Mockups: Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
    - a. Wall Surfaces: Provide samples on at least 100 sq. ft.
    - b. Small Areas and Items: Architect will designate items or areas required.

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
  - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
3. Final approval of colors will be from benchmark samples.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
  1. Product name or title of material.
  2. Product description (generic classification or binder type).
  3. Manufacturer's stock number and date of manufacture.
  4. Contents by volume, for pigment and vehicle constituents.
  5. Thinning instructions.
  6. Application instructions.
  7. Color name and number.
  8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
  1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

#### 1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
  1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

#### 1.8 EXTRA MATERIALS

- 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-#): Refer to the Finish Schedule on the Drawings.
- 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.
- E. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 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 Tufcryn 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 Tufcryn 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), Aliphatic 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 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 Fluoropolymer at 3.0 mils DFT.
6. 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.
7. 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.
8. Exterior Wood and Cellular PVC, for Painted Finish:
- a. Factory Primed per Section 062010 - EXTERIOR FINISH CARPENTRY.

- b. One Coat, Primer:
  - 1) California Paint Grip-Coat Bonding Primer 505 series.
  - 2) Duron Bond N-Seal Exterior Acrylic Latex Primer 08-124.
  - 3) Moore Ultra Spec Exterior Primer N558.
  - 4) PPG Seal Grip Acrylic Latex Primer.
  - 5) S-W Exterior Latex Acrylic Wood Primer.
  
- c. And Two Coats, Flat Finish:
  - 1) California Paint Fresh Coat 100% Acrylic Velvet Flat 450 series.
  - 2) Duron Weathershield Exterior 100% Acrylic Flat House Paint 34-914.
  - 3) Moore Ultra Spec Exterior Flat Finish N447.
  - 4) PPG Sun-Proof Exterior Flat Latex 72 line, N105 or 183.
  - 5) S-W SuperPaint VinylSafe Exterior Latex Acrylic Flat A80 series.
  
- d. And Two Coats, Semi-Gloss Finish:
  - 1) California Paint Fresh Coat 100% Acrylic Satin-Gloss 471 series.
  - 2) Duron Weathershield Exterior 100% Acrylic Semi-Gloss House Paint.
  - 3) Moore Ultra Spec Exterior Gloss Finish N449.
  - 4) PPG Sun-Proof Exterior Semi-Gloss Latex 78 line, N096 or 170.
  - 5) S-W SuperPaint VinylSafe Exterior Latex Acrylic Satin A89 series.

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 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.
  
  - d. And Two Coats, Semi-Gloss Finish: At toilet rooms, other wet areas, and elsewhere as indicated.
    - 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.
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 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.
4. Interior Metals (Not specified to receive other coating systems/not shop finished), Acrylic Paint Finish:
  - a. One Coat: Approved primer, in shop under other Sections (where specified). If not shop primed, provide primer recommended by finish coating manufacturer.
  - b. And Two Coats:
    - 1) Moore Ultra Spec 500 Interior Latex Semi-Gloss 539.
    - 2) PPG Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
    - 3) S-W ProMar 200 HP Zero VOC Interior Semi-Gloss.
5. Interior Exposed Steel, Joists, Ductwork, 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.
6. Interior Concrete Floor, Clear Exposed Sealer (Silicate type):
- a. One Coat:
    - 1) Curecrete Chemical; Ashford Formula.
    - 2) Tnemec (Chem Probe); Series 629 CT Densifyer.
    - 3) WR Meadows; Liqui-Hard.
    - 4) Laticrete; L&M Seal Hard.
    - 5) Prosoco; Consolideck LS.
- D. Mechanical and Electrical Work: Paint all exposed items throughout the project except factory finished items with factory-applied baked enamel finishes which occur in mechanical rooms or areas, and excepting chrome or nickel plating, stainless steel, and aluminum other than mill finished. Paint all exposed ductwork and inner portion of all ductwork. Same as specified for other interior metals, hereinabove.

END OF SECTION

## SECTION 101400

### SIGNAGE

#### PART 1 - GENERAL

##### 1.1 GENERAL PROVISIONS

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

##### 1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Code-required interior panel signage, including but not limited to, accessibility signage, toilet room signage and mechanical and electrical room signage.
  - 2. Exterior building signage.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Division 26 - ELECTRICAL for illuminated exit signs.

##### 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
- B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
  - 1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.
- C. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
  - 1. Panel Signs: Full-size Samples of each type of sign required.
  - 2. Approved samples will not be returned for installation into Project.
- D. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

##### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

- B. Regulatory Requirements: Comply with the Massachusetts Architectural Access Board, Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

#### 1.6 COORDINATION

- A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

### PART 2 - PRODUCTS

#### 2.1 PANEL SIGNS

- A. General: Provide signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction as indicated. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally. Provide the following:

- 1. Code-Required Signs for Certificate of Occupancy:

- a. Type: Photopolymer on acrylic or printed acrylic / aluminum as applicable.
- b. Color: Selected from manufacturer's standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal.
- c. Type Size: As selected.
- d. Typeface: As selected.

- 2. Interior Signs Based on Owner's Requirements:

- a. Type: Photopolymer on acrylic or printed acrylic as applicable.
- b. Color: Selected from manufacturer's standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal.
- c. Type Size: As selected.
- d. Typeface: As selected.

- 3. Exterior Signs:

- a. Type: As indicated on the Drawings.

- B. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.

- 1. Raised-Copy Thickness: Not less than 1/32 inch

- C. Symbols of Accessibility: Provide 6-inch- high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.

## 2.2 ACCESSORIES

- A. Mounting Methods: Use double-sided vinyl tape fabricated from materials that are not corrosive to sign material and mounting surface.
- B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
  - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
  - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:
  - 1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

### 3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by the Architect.

END OF SECTION

SECTION 102110  
TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Stainless steel toilet compartments and screens, floor-mounted and overhead braced.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 102800 - TOILET ACCESSORIES for partition mounted accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locations of cutouts for compartment-mounted toilet accessories.
- C. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable provisions of Massachusetts Architectural Access Board and the Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG) for compartment door operating hardware and compartments designated as accessible."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without

field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

## 1.6 COORDINATION

- A. Coordinate with the work of Section 061000 - ROUGH CARPENTRY for locations requiring wood blocking or flat plate reinforcing within partitions for compartment mounting.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. 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. Accurate Partitions Corporation.
  - 2. Bradley Corporation; Mills Partitions.
  - 3. Flush Metal Partition Corp.
  - 4. General Partitions Mfg. Corp.
  - 5. Global Steel Products Corp.
  - 6. Hadrian Manufacturing Inc.
  - 7. Knickerbocker Partition Corporation.
  - 8. Metpar Corp.

### 2.2 STAINLESS-STEEL UNITS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.
- C. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
  - 1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
  - 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
  - 3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- D. Urinal-Screen Construction: Matching panel construction.
- E. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:
  - 1. Pilasters: Manufacturer's standard thickness, but not less than 0.038 inch.
  - 2. Panels: Manufacturer's standard thickness, but not less than 0.031 inch.
  - 3. Doors: Manufacturer's standard thickness, but not less than 0.031 inch.
  - 4. Flat-Panel Urinal Screens: Thickness matching the panels.

- F. Brackets and Fittings: Manufacturer's standard design.
  - 1. Material: Stainless steel.
  - 2. Full-Height (Continuous) Type Brackets: Stainless steel.
  - 3. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- G. Stainless-Steel Finish: No. 4 bright, directional polish on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

## 2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
  - 1. Material: Stainless steel.
  - 2. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
- B. Overhead Bracing: Manufacturer's standard continuous, stainless steel head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

## 2.4 FABRICATION

- A. Floor-Mounted, Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

- a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
  - b. Align brackets at pilasters with brackets at walls.
- B. Floor-Mounted, Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION

SECTION 102600

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Corner guards.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 055000 - METAL FABRICATIONS.
  - 2. Section 087100 - DOOR HARDWARE for metal armor, kick, mop, and push plates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Corner Guards: 12 inches long.
- C. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.
  - 1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Sections.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
  2. Keep plastic sheet material out of direct sunlight.
  3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.
- D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  1. Wood Glues: 30 g/L.
  2. Contact Adhesive: 80 g/L.
  3. Special Purpose Contact Adhesive: 250 g/L.

#### 2.2 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards: Fabricated from 1-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Balco, Inc.
  - b. Boston Retail Products.
  - c. Construction Specialties, Inc.
  - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
  - e. Korogard Wall Protection Systems; Division of RJF International Corporation.
  - f. Nystrom Building Products.
  - g. Pawling Corporation.
2. Material: 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.

### 2.3 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

### 2.4 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  1. Remove tool and die marks and stretch lines or blend into finish.
  2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### 2.5 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 impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

#### 3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  1. Provide mounting hardware, anchors, and other accessories required for a complete installation.

#### 3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a low VOC, non-ammonia-, non-chlorine, and non-solvent-based, household cleaning agent.

END OF SECTION

SECTION 102800  
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Toilet accessories as scheduled on the Drawings. Coordinate with Owner for accessories provided by Owner.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 061000 - ROUGH CARPENTRY for blocking.
  - 2. Section 088000 - GLAZING for frameless mirrors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
  - 2. Identify products using designations indicated on Drawings.

- C. Maintenance Data: For toilet accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

## 1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.

### 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 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. 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.
- E. Door Material: Steel sheet with baked enamel finish, color as selected.
- F. Door Style: Vertical duo panel with frame.
- G. Door Glazing: Tempered glass.
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- I. Accessories:
  - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

## 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

## 2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  - 1. Weld joints and grind smooth.
  - 2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick, fire-barrier material.
    - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

- B. Examine fire extinguishers for proper charging and tagging. Contractor shall be responsible for fire extinguisher tagging by a certified service technician located within 75 miles of the project.
  - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

### 3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated on the Drawings and acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
  - 1. 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 105720

### WIRE CLOSET AND UTILITY SHELVING

#### PART 1 - GENERAL

##### 1.1 GENERAL PROVISIONS

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

##### 1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Wire shelving at closets and utility/storage closets.
- 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 and nailers.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of shelving indicated. Include installation details, materials, individual components and profiles, and finishes.
- B. Samples: For each type of shelving material, 12 inches long, in specified finish.
- C. Shelving Schedule: Provide complete shelving schedule, including types, locations, sizes, and other data pertinent to installation.

##### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain shelving and accessories through one source from a single manufacturer.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver storage shelving palletted, wrapped, or crated to provide protection during transit and Project-site storage.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Schulte Corporation.

## 2.2 COMPONENTS

- A. Series: "Lifetime Ventilated Series 1110-1212-11 Shelf with Hanging Rod"
1. 12-inch Shelf: Model No. 1710-1212-11
  2. Clip with TriLoc II Anchor Versa: Model No. 1435-6620-11
  3. Sidewall Bracket with TriLoc II Anchor: Model No. 1435-6621-11
  4. Support Brace: Model No. 1435-6659-11

- B. ADA Series: "Series 1210-1212-11 Storage Shelf"

## 2.3 SHELVING

- A. Wire Shelves: One (1) shelf with hanging rod to be provided. Top Shelf to be full width of closet.

1. Shelf Depth: 12 inches.

- B. ADA Wire Shelves: Four (4) additional 18" wide stacked shelves located to one side of closet below top shelf with Series 1210-1212-11 Storage Shelves.

1. Storage Shelves to begin 16" from floor and stacked at 13" intervals (16", 29", 42", and 55")

- C. Materials:

1. Steel Rod: Grade C 1008 cold drawn steel rod. Tensile strength of 100 ksi.
2. Front Rods and Studs: 0.306 inch diameter.
3. Back Rods: 0.243 inch diameter.
4. Cross Wires:
  - a. 1 Inch Spacing: 0.120 inch diameter for one inch spaced standard 20 inches shelf.  
0.120 inch diameter for one inch spaced standard mesh shelf.
  - b. 1/2 Inch Spacing: .0915 inch diameter for one-half inch spaced tight mesh shelf.

- D. Components:

1. Hanging Shelf with Open Slide: 12 inches deep by length as shown on Drawings.
2. Mounting Hardware: Manufacturer's standard components including anchor clips, end brackets, angled support braces and end caps, including the following:
  - a. Side Wall Bracket: As required. Shelf side wall interface.
  - b. Anchor Back Clips.
  - c. Fasteners, clips, caps and touch-up all as required.
  - d. Down Back Clips.

- E. Finish: Electrostatic applied oven cured epoxy at all surfaces to 3 to 5 mil (0.075 to 0.127 mm) thickness.

1. Color: Pure White

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing wire shelving.

END OF SECTION

## SECTION 113100

### APPLIANCES

#### PART 1 - GENERAL

##### 1.1 GENERAL PROVISIONS

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

##### 1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Appliances.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Division 22 - PLUMBING for water distribution piping connections, drainage and vent piping connections, sinks, and waste disposers.
  - 2. Division 26 - ELECTRICAL for services and connections to appliances.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.
- B. Appliance Schedule: For appliances; use same designations indicated on Drawings.
- C. Maintenance Data: For each product to include in maintenance manuals.
- D. Warranties: Special warranties specified in this Section.

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Provide products from same manufacturer for each type of appliance required.
- C. Regulatory Requirements: Comply with provisions of the following product certifications:
  - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
  3. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
- D. Regulatory Requirements, Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with Massachusetts Architectural Access Board requirements and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- E. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.
1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
- F. Switches: Provide mercury-free switches in appliances.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
- 1.5 WARRANTY
- A. Special Warranties: Manufacturer's standard form in which manufacturer of each appliance specified agrees to repair or replace residential appliances or components that fail in materials or workmanship within manufacturer's standard warranty period.

## PART 2 - PRODUCTS

### 2.1 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.

- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to Division 22 - PLUMBING for plumbing requirements and Division 26 - ELECTRICAL for electrical requirements.

### 3.3 CLEANING AND PROTECTION

- A. Test each item to verify proper operation. Make necessary adjustments.
- B. Verify that accessories required have been furnished and installed.
- C. Remove packing material from appliances and leave units in clean condition, ready for operation.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain appliances.

END OF SECTION

SECTION 122400

SHADES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Roller shades with manual shade operators.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
  - 1. Section 061000 - Rough Carpentry for wood blocking and grounds for mounting roller shades and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Ceiling suspension system members and attachment to building structure.
  - 2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
  - 3. Shade mounting assembly and attachment.
  - 4. Size and location of access to shade operator and adjustable components.
  - 5. Minimum Drawing Scale: 1/4 inch = 1 foot.
- D. Samples for Initial Selection: For each colored component of each type of shade indicated.
  - 1. Include similar Samples of accessories involving color selection.
- E. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated.
2. For the following products:
  - a. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.
  - b. Valance: Full-size unit, not less than 12 inches long.
- F. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.
- G. Product Certificates: For each type of roller shade, signed by product manufacturer.
- H. Qualification Data: For Installer.
- I. Product Test Reports: For each type of roller shade.
- J. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
  1. Methods for maintaining roller shades and finishes.
  2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
  3. Operating hardware.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Flame-Resistance Ratings: Passes NFPA 701.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Draper Inc.
  - 2. Hunter Douglas Contract; Nysan Shading Systems.
  - 3. MechoShade Systems, Inc.

### 2.2 ROLLER SHADES

- A. Shadecloth: Transparent (1% or greater), 100% polyester or PLA biopolymer fabric, PVC-free.
  - 1. Available Products:
    - a. MechoShade; EcoVeil Sheer, 6850 and 6750 Series.
    - b. M+N Textiles; Revolution.
  - 2. Fire-Test-Response Characteristics: Passes NFPA 701, with no chemical flame retardants.
  - 3. Building Product Disclosure and Optimization, Material Ingredients: Cradle to Cradle (C2C) Gold certification.
  - 4. Low-Emitting Materials: Provide adhesives and sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - a. GreenGuard Gold certification.
  - 5. Bottom Hem: Straight.
  - 6. Colors: To be selected by Architect from manufacturer's full range.
- B. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material.
  - 1. Direction of Roll: Regular, from back of roller

- C. Mounting Brackets: Galvanized or zinc-plated steel.
- D. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings removable design for access.
- E. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
- F. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.
- G. Bottom Bar: Steel or extruded aluminum. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.
- H. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.
- I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard for anchoring roller shade bottom in place and keeping shade band material taut.

## 2.3 ROLLER SHADE FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
  - 1. Lifting Mechanism: With permanently lubricated moving parts.
- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
  - 1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
  - 2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

- F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

#### 2.4 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  - 1. Bead Chains: Manufacturer's standard.
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

#### 3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

#### 3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.
- B. 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.
- C. Each sub-bid filed with the Awarding Authority must be accompanied by BID BOND, or CASH or CERTIFIED CHECK or a TREASURER'S CHECK or CASHIERS'S CHECK issued by a responsible bank or trust company, payable to the Owner in the amount of five percent (5%) of the bid amount. A sub-bid accompanied by any other form of bid deposit will be rejected.
- D. Each sub-bid, submitted for the work of this Section, shall be on a form furnished by the Awarding Authority, as required by Section 44F of Chapter 149, as amended.
- E. Sub-Sub-Bid Requirements:
  - 1. CLASS OF WORK: REFERENCE ARTICLE
    - a. Plumbing Insulation: Section 22 0700 – Plumbing Insulation
- F. The following drawings shall be part of this filed sub-bid section.

PLUMBING DRAWINGS

P0.00	PLUMBING ABBREVIATIONS, NOTES AND SYMBOLS
PD1.00	PLUMBING DEMOLITION FLOOR PLAN
P1.00	PLUMBING BASEMENT FLOOR PLAN
P1.01	PLUMBING FIRST FLOOR PLAN
P1.02	PLUMBING SECOND FLOOR PLAN
P5.00	PLUMBING DETAILS
P5.01	PLUMBING DETAILS
P6.00	PLUMBING SCHEDULES

- G. The following specifications shall be part of this filed sub-bid section.

22 0000	Plumbing Filed Sub-bid
22 0400	General Conditions for Plumbing
22 0517	Sleeves and Sleeve Seals for Plumbing Piping
22 0523	General Duty Valves for Plumbing Piping
22 0529	Hangers and Supports for Plumbing Piping and Equipment
22 0553	Identification for Plumbing Piping and Equipment
22 0700	Plumbing Insulation
22 1005	Plumbing Piping
22 2123	Plumbing Pumps
22 3000	Plumbing Equipment
22 4000	Plumbing Fixtures

1.2 FILING OF SUB-BIDS:

- A. Include GENERAL CONDITIONS and applicable parts of Division 1 as part of this Section.
- 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.

1.3 SCOPE OF WORK

- A. The scope of work consists of the installation of all materials to be furnished under Division 22 and without limiting the generality thereof, consists of furnishing all labor, materials, equipment, plant, transportation, rigging, staging up to roof, appurtenances, and services necessary and/or incidental to properly complete all work as shown on the Plumbing drawings, as described in the Specifications, or as reasonably inferred from either, in the opinion of the Architect.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. The following related work or materials shall be provided under the designated Sections and coordinated by the Contractor:
  - 1. Cutting and Patching including openings in concrete masonry floors, walls and roof: The file sub bid contractor is responsible for cutting and patching as indicated in Specification 01 73 19.
  - 2. Staging and Scaffolding: Where staging and scaffolding is required, the Filed Subcontractor shall provide the entire installation for the scope of work. Refer to Section 01 50 00 "Temporary Facilities and Controls".
    - a. Staging shall be of approved design, erected and removed by experienced stage builders and shall have all accident prevention devices required by State and local laws.
  - 3. Access doors and frames shall be furnished by the Filed Subcontractor for installation by the General Contractor in accordance with Section 08 31 13 "Access Doors and Frames".
  - 4. Lifting and Hoisting: Where lifting and hoisting is required, the Filed Subcontractor shall provide the entire installation for the scope of work. Refer to Section 01 50 00 "Temporary Facilities and Controls".

1.5 SUBMITTALS

- A. Attention is directed to Specification Section 013300 Submittal Procedures and Section 220400 General Conditions for Plumbing Trades.

1.6 RECORD DRAWINGS

- A. Refer to Specification Section 017839 Project Record Documents and Section 220400 General Conditions for Plumbing Trades for the Record Drawing requirements for this section.
- B. The marked up As Built Drawings required to be maintained under this section are of the following Drawings:  
  

ALL DRAWINGS LISTED IN PARAGRAPH 1.1(F) OF THIS SECTION.
- C. Availability of marked up As Built drawings shall be a prerequisite to scheduling final inspection of this contract and said drawings and original contract documents will be used in checking completion of the work.
- D. Non-availability of marked up As Built drawings or inaccuracies therein may be grounds for cancellation and postponement of any scheduled final inspection by the Architect until the discrepancy has been corrected.

#### 1.7 OPERATING AND MAINTENANCE MANUALS

- A. Refer to Section 220400 General Conditions for Plumbing Trades for the Operating and Maintenance Manual requirements for this Contract.
- B. The Plumbing subcontractor shall provide the Contractor five (5) sets of operating and maintenance instructions of all Plumbing and Plumbing equipment furnished and installed under this section.
- C. The Contractor shall collect the operating instructions, bind them into two complete sets and deliver them to the Architect who will check for completeness and deliver them to the Owner.
- D. Delivery of the operating and maintenance manuals shall be a condition precedent to final payment.

#### 1.8 INSTRUCTION OF OWNER'S PERSONNEL

- A. Refer to Section 220400 General Conditions for Plumbing Trades for the Instruction of Owner's Personnel requirements for this Contract.
- B. The Plumbing subcontractor shall instruct the Owner's personnel, at the site, in the use and maintenance of equipment installed under this section.
- C. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative shall be a condition precedent to final payment.

#### 1.9 GUARANTEE AND SERVICE

- A. Notwithstanding any other requirements of this contract, the Plumbing Subcontractor shall guarantee the performance of the installation and equipment included in this Section for one year from the date of Substantial Completion as defined in the General Conditions. Should any defects in materials or workmanship appear during this period, they shall be corrected or replaced by the Plumbing Subcontractor to the satisfaction of the Architect, and at no expense to the Owner.

#### 1.10 PERMITS

- A. The subcontractors attention is directed to the General Conditions. This subcontractor shall be responsible for obtaining and paying for all permits and inspections required to complete all Work described in this section.

#### PART 2 MATERIALS

- A. Refer to specification sections referenced in 1.11 above for specific material requirements for work of this section.

#### PART 3 EXECUTION

- A. Refer to specification sections referenced in 1.11 above for specific execution requirements for work of this section.

END OF SECTION

SECTION 22 04 00

GENERAL CONDITIONS FOR PLUMBING TRADES

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section applies to certain sections of Division 26, "Electrical," and this section applies to all sections of Division 22, "Plumbing" of this project specification unless specified otherwise in the individual sections.
- C. The Drawings of other trades (Architectural, Food Service, Structural, Landscape, Civil, Mechanical, Fire Protection and Electrical) shall be examined for coordination and familiarity of work with other Contractors. Any duplication or omission of provisions in this project should be brought to the attention of the Owners prior to Bidding.

1.3 DESCRIPTION

- A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.
- B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division. Where conflicts exist between the drawings and the specifications or between this section of the specifications and other sections, the more stringent or higher cost option shall apply.

1.4 INTENT

- A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation. Provide all parts necessary for the intended use, fully complete and operational, and installed in professional manner in accordance with the design intent.
- B. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.

- C. Minor details not usually shown or specified but necessary for proper installation and operation shall be included in the work as though they were hereinafter shown or specified.
- D. Work under each Section shall include giving written notice to the Owner and Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section includes the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

## 1.5 DEFINITIONS

- A. "Approved equal" also known as "alternative" mean any product which in the opinion of the Engineer is equal in quality, arrangement, appearance, and performance to the product specified.
- B. No Exceptions Taken – reviewed and determined to be in general conformance with contract documents.
- C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.
- D. "Finished" refers to all rooms and areas to be specified to receive architectural treatment as indicated on the drawings. All rooms and areas not covered, including underground tunnels and areas above ceilings shall be considered not finished, unless otherwise noted.
- E. "Furnish" or "supply" shall mean purchase, deliver to, and off-load at the job site, ready to be installed including where appropriate all necessary interim storage and protection.
- F. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- G. "Install" shall mean set in place complete with all mounting facilities and connections as necessary ready for normal use or service.
- H. "Lead Free" shall mean not more than .25% in the wetted surface area.
- I. No Exceptions Taken – reviewed and determined to be in general conformance with contract documents.
- J. "Product" shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- K. "Provide" shall mean furnish (or supply) and install as necessary.
- L. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

- M. Remove: The term “remove” means “to disconnect from its present position, remove from the premises and to dispose of in a legal manner.”
- N. Special Warranties: The term “Special Warranties” are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.
- O. Standard Product Warranties: The term “Standard Product Warranties” are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- P. “Subcontractor” means specifically the subcontractor working under this Division. Other Contractors are specifically designated “Plumbing Subcontractor”, “General Contractor” and so on. Note: Take care to ascertain limits of responsibility for connecting equipment which requires connections by two or more trades.
- Q. Substitutions: Requests for changes in products, materials, equipment, and methods of construction proposed by the Contractor are considered requests for "substitutions."
- R. “Wiring” shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.

#### 1.6 CONTRACT DOCUMENTS

- A. The two dimensional drawings govern the construction. They show the design intent and are part of the Contract Documents. BIM models are not part of contract documents. They are developed for convenience only.
- B. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect. (Do not scale the drawings)
- C. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Owner and Engineer shall be notified before proceeding with installations.
- D. The Owner may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.

#### 1.7 DISCREPANCIES IN DOCUMENTS

- A. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, shall be included in the Contract price. The Owner and Engineer shall decide on the item and the manner in which the work shall be installed.
- B. Where Drawings or Specifications conflict or are unclear, submit clarification request in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or un-clarities thus resolved.

- C. Where Drawings or Specifications do not coincide with manufacturers' recommendations or with applicable codes and standards, submit clarification request in form of an RFI before installation. Otherwise, make changes in installed work required for compliance with manufacturer instructions or codes and standards within Contract Price.
- D. Where insufficient information exists in the documents to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements, where notification required by Paragraph (B) above has not been submitted, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in professional manner either concealed or exposed in accordance with the design intent.
- E. Where discrepancies exist between the mechanical, plumbing, fire protection, and electrical drawings in regards to what trade owns disconnects or starters, the discrepancy shall be brought to the Architect's attention in accordance with paragraph (B) above. If the scope is not resolved prior to the Award of Contract, Division 26 shall provide such items.

## 1.8 SURVEYS AND MEASUREMENTS

- A. Before submitting the Bid, the Contractors shall visit the site and become thoroughly familiar with all existing conditions under which work will be installed. This Contract includes all modifications of existing systems required for the installation of new equipment. This Contract includes all necessary offsets, transitions and modifications required to install all new equipment in existing spaces. All new and existing equipment and systems shall be fully operational under this Contract before the job is considered complete. The Contractors shall be held responsible for any assumptions made, any omissions or errors made as a result of their failure to become fully familiar with the existing conditions at the site and the Contract Documents.
- B. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or which interfere with the intent of the Drawings and Specifications, the Engineer will be notified and work will not proceed until instructions from the Engineer are received.

## 1.9 CODES AND STANDARDS

- A. Reference Standard Compliance
  - 1. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.
  - 2. Independent Testing Organization Certificate: In lieu of the label or listing indicated above, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified

organization's test methods and that the item complies with the specified organization's reference standard.

- B. Wherever Codes and/ or standards are mentioned in these specifications, the latest applicable edition or revision of the local building or life safety code shall be followed.
- C. The following Standards shall be used where referenced by the following abbreviations:

ACGIH	American Conference of Governmental Industrial Hygienists
AGA	American Gas Association
AIA	American Institute of Architects
ANSI	American National Standards Institute
API	American Petroleum Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CGA	Compressed Gas Association
CSA	Canadian Standards Association
CISPI	Cast Iron Soil Pipe Institute
EJMA	Expansion Joint Manufacturing Association
EPA	Environmental Protection Agency
FM	Factory Mutual
FSSC	Federal Specification
HIS	Hydraulic Institute Standards
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
ISO	Insurance Services Office

MCAA	Mechanical Contractors Association of America
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NOFI	National Oil Fuel Institute
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PDI	Plumbing and Drainage Institute
SBI	Steel Boiler Industry (Division of Hydronics Institute)
SDWA	Safe Drinking Water Act
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
STI	Steel Tank Institute
UL	Underwriters' Laboratories

- D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.
- E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

#### 1.10 PERMITS AND FEES

- A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the work, file all necessary Drawings, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspection for his work, and deliver a copy to the Owner and Engineer before request for acceptance and final payment for the work.

#### 1.11 EQUIPMENT EQUIVALENTS AND SUBSTITUTIONS

- A. Certain manufacturers of material, apparatus or appliances are indicated in the drawings and specifications for this project. These items have been used as the basis of design, and as a convenience in fixing the minimum standard of quality, finish and design that is required. If the Contractors uses an "approved equal" alternative to the basis of design,

and if the features of that alternative have an impact on other components of the Project, the Contractor shall include the necessary adjustments in those components, whether for architectural, structural, mechanical, electrical, fire protection, or any other elements, plus any adjustments for difference in performance.

- B. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for Architect and Engineer review.
- C. Where the Contractor proposes to use an item that is different from the basis of design in the Drawings and specifications, and that will require the redesign of the structure, partitions, foundations, piping, wiring or any other component of the mechanical, electrical, or architectural layout, the Contractor shall provide the necessary redesign of those components.
- D. Where the Contractor proposes to deviate (provide an equivalent or request for substitution) from the basis of design scheduled equipment or materials as hereinafter specified or shown on the drawings, they are required to submit a requested for substitution in writing. The Contractor shall state in their request whether it is a substitution, equivalent or a non-approved equivalent to that specified and the amount of credit or extra cost involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.
- E. If an alternative or substitute item results in a difference in quantity and arrangement of structure, piping, ductwork, valves, pumps, insulation, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such additional equipment required by the system, at no additional cost to the Owner including any costs added to other trades due to the equivalent change from the basis of design detailed in the drawings or included within the specifications.
- F. Equipment, material or devices submitted for review as a "substitution" shall meet the following requirements:
  - 1. Substitution Request Submittal: Requests for substitution will be considered if received in writing 14 days before the bid date. Requests received later than 14 days before the bid date may be considered or rejected at the discretion of the Engineer/Owner. Once the Contractor submits a complete request for substitution as determined by the engineer, the engineer reserves the right to request the time necessary to evaluate the request for substitution and review it with the Owner.
  - 2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
    - a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
    - b. Samples, where applicable or requested.
    - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.

- d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
- e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
- f. Cost information, including a proposal of the net change, if any in the Contract Sum.
- g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
- h. Engineer's Action: Within one week of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance of a product substitution will be in the form of an Addendum.
- i. Other Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.
  - 1) The request is directly related to an "or equal" clause or similar language in the Contract Documents.
  - 2) The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
  - 3) A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

#### 1.12 SUBMITTAL PROCEDURES

- A. Provide Submittals in accordance with the requirements of Division 01 and as indicated in the following.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
  2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
1. Allow ten business days for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
  2. If an intermediate submittal is necessary, process the same as the initial submittal.
  3. Allow ten business days for reprocessing each submittal.
  4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.
- D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block. Submittals shall be arranged in order of specification sections.
1. Include the following information on the label for processing and recording action taken.
    - a. Project name.
    - b. Date.
    - c. Name and address of Engineer.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Number, title and paragraph of appropriate Specification Section.
    - i. Drawing number and detail references, as appropriate.

- E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.
- F. Except for submittals for record, information or similar purposes, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.
- G. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, to indicate the action taken.

### 1.13 SHOP DRAWINGS

- A. Submit neatly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
- B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated plumbing layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review all shop drawings to be incorporated in the Plumbing Contract.
- C. Provide shop drawings for all devices specified under equipment specifications for all systems. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, dimensions, identification of products and materials included, compliance with specified standards, notation of coordination requirements, notation of dimensions established by field measurement and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures), of all shop drawings, performance cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.
- D. When a submittal could involve more than one trade, e.g., valves, piping, etc., the submitted shall be separated by traded involved, ie. HVAC, plumbing, fire protection, etc.
- E. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.
- F. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.
- G. "No Exception Taken" rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval does not in any way

relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings. Review of shop drawings shall not apply to quantity of material.

- H. After shop drawings have been reviewed, with no exceptions taken, no further changes will be allowed without the written consent of the Engineer.
- I. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.
- J. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer in writing at least five (5) working days prior to bidding to allow for issuance of an Addendum.
- K. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.
- L. All submittals shall be made in electronic PDF format with searchable OCR (Optical Character Recognition) format. This excludes scanned and faxed materials.

#### 1.14 COORDINATION DRAWINGS AND BIM MODEL

- A. Coordination drawings are required for all fire protection, plumbing, mechanical and electrical trades. The content and procedures described in Division 01 shall be followed, with the additional requirements specifically for the plumbing and electrical trades as described in this Section. If a BIM model is not used on this project, the below requirements shall be accomplished in CAD.
- B. Prepare coordination drawings in accordance with Division 01 to a minimum scale of 1/4"=1'-0" detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
  - 1. The Contractor shall indicate the proposed locations of piping, conduit, ductwork, equipment, and materials. Include the following:
    - a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    - b. Equipment connections and support details.
    - c. Exterior wall and foundation penetrations.
    - d. Fire-rated wall and floor penetrations.
    - e. Sizes and locations of required concrete pads and bases.
- C. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

- D. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
- E. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
- F. The Contractor and each subcontractor shall sign and date each coordination drawing prior to submission.
- G. Work shall not be performed until coordination drawings have been approved by the architect and engineer.
- H. Electronic copies of the MEP floor plans and/or BIM model are available to use as a basis for preparing coordination drawings and can be provided by the Engineer. If the Contractor elects to obtain the Engineers electronic files an Electronic Drawing File Release Form must be submitted. This form must be signed by the Contractor, Owner, and Architect. Upon receipt of a signed copy of the Electronic Drawing File Release Form, the Engineer will provide copies of the electronic files for the Contractor's use. A copy of the Electronic Drawing File Release Form is appended to the end of this specification section
- I. Review by Engineer of coordination drawings is limited to confirming that requirements for coordination and preparation of plans have been complied with by the Contractor and shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with Architectural, Structural, Mechanical, Electrical and other related work.

#### 1.15 COORDINATION WITH OTHER DIVISIONS

- A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.
- B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, HVAC piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.
- C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.
- D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.
- E. The two dimensional drawings are diagrammatic. They indicate general arrangements of mechanical systems and other work, and are intended to convey sufficient information for skilled contractors and tradespeople to furnish and install complete systems. 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, provide all other components and materials to make the systems fully complete, coordinated with other systems and the structure and space available, and operational. Similarly, the drawings 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 in order to avoid interferences and to meet ceiling heights and other Architectural requirements. Establish and provide offsets, changes in direction, and exact routings to coordinate all systems. Where conflicts or potential conflicts exist and engineering guidance is desired, submit a "Request for Information" (RFI).

- F. Controls contractor shall coordinate and sequences of operation with all other trades as necessary to provide a complete and functioning system.

#### 1.16 QUALITY CONTROL

- A. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.
- C. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled tradespeople, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.
- D. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.
- E. All labor for installation of plumbing systems shall be performed by experienced, skilled tradespeople under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, professional manner. The Engineer reserves the right to reject any work which, in their opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

#### 1.17 SHUTDOWNS

- A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner.
- B. The Engineer and the Owner shall be notified in writing of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.

- C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

#### 1.18 TEMPORARY UTILITIES

- A. General: Provide new materials and equipment; if acceptable to the Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
- C. First Aid Supplies: Comply with governing regulations.
- D. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.
- E. Utilities: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
  - 1. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Engineer, and will not be accepted as a basis of claims for a Change Order.
- F. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.
- G. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.
- H. Termination and Removal: Unless the Engineer requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

#### 1.19 EQUIPMENT ACCESS

- A. Appliances, controls devices, valves and accessories that utilize energy shall be accessible for inspection, service, repair and replacement without disabling the function

of a fire-resistance-rated assembly or removing permanent construction, other appliances, venting systems or any other piping not connected to the appliance being inspected, serviced, repaired or replaced. A level working space not less than 30 inches deep and 30 inches wide shall be provided in front of the control side to service an appliance.

#### 1.20 PROJECT PHASING

- A. Work under each Section shall include all necessary temporary connections, equipment, piping, heating, temperature control work, fire stopping, water heaters, labor, and material as necessary to accommodate the phasing of Construction as developed by the General Contractor or Construction Manager and approved by the Owner. All existing systems that pass-thru an area of the building shall remain operational during all phases of construction. No extra compensation shall be granted the Contractor for work required to maintain existing systems operational or to accommodate the construction phasing of the project.

#### 1.21 PROTECTION OF MATERIALS AND EQUIPMENT

- A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or tradespeople and shall include making good all damage thus caused.
- B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.
- C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.
- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by tradespeople or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

#### 1.22 ADJUSTING AND TESTING

- A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.
- B. Where requested by the Engineer, a factory-trained service representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service representative shall supervise the initial operation of the equipment and instruct personnel responsible for operation and maintenance of the equipment. The service representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

### 1.23 CLEANING

- A. The Contractor shall thoroughly clean and flush all piping and equipment of all foreign substances, oils, burrs, solder, flux, etc., inside and out before being placed in operation.
- B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.
- C. During the course of construction, all pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.
- D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.
- E. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
  - 1. Remove labels that are not permanent labels.
  - 2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
  - 3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
  - 4. Wipe surfaces of plumbing equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition.
- F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove and dispose of ALL waste materials, packaging material, skids etc. from the site and dispose of in a lawful manner in accordance with municipal, state and federal regulations.
- G. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

### 1.24 OPERATING AND MAINTENANCE

- A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least seven (7) days' notice to the Owner and the Engineer in advance of this period.

- B. The Contractor shall include the maintenance schedule for the principal items of equipment furnished under this Division.
- C. The Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.
- D. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection: pumps; controls, water heaters, compressors, boilers etc. These letters shall be bound into the operating and maintenance books.
- E. Refer to individual trade Sections for any other particular requirements related to operating instructions.
- F. Demonstration shall be recorded on USB Flash drive and turned over to the Owner. Video recording shall be done in a professional manner with quality video (1080p resolution) and clear audible sound.

#### 1.25 OPERATING AND MAINTENANCE MANUALS

- A. Prepare operating and maintenance manuals in accordance with the requirements of Division 01 and as follows. The Contractor shall prepare up to six (6) copies of a complete maintenance and operating instructions manual, bound in booklet form. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 3-ring vinyl-covered binders, with pocket folders for folded sheet information and designation partitions with identification tabs. Mark appropriate identification on front and spine of each binder.
- B. Manual shall 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 replacement parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - 4. Servicing and operating instructions including lubrication charts and schedules.
  - 5. Emergency and safety instructions.
  - 6. Spare parts list.
  - 7. Copies of warranties.
  - 8. Wiring diagrams.
  - 9. Recommended "turn around" cycles.

10. Inspection procedures.
  11. Approved Shop Drawings and Product Data.
  12. Equipment Start-up Reports.
  13. Balance reports.
- C. Include in the manual, a tabulated equipment schedule for all equipment. Schedule shall include pertinent data such as: make, model number, serial number, voltage, normal operating current, belt size, bearing number, etc. Schedule shall include maintenance to be done and frequency.
- D. Maintenance and instruction manuals shall be submitted to the Owner at the same time as the seven (7) day notice is given prior to the instruction period.

#### 1.26 ACCEPTANCES

- A. The equipment, materials, quality, design and arrangement of all work installed under the Plumbing Sections shall be subject to the review of the Engineer.
- B. Within 30 days after the awarding of a Contract, the Plumbing Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Plumbing Sections. The intent to use the exact manufacturers and models specified does not relieve the Contractor of the responsibility of submitting such a list.
- C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Owner and Engineer, in writing, within 30 days of award of the Contract. In such instances, equipment substitutions may be made pending acceptance by the Engineer or the Owner's representative.
- D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Plumbing Contractor shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.
- E. If material or equipment is installed before it is reviewed and/or approved, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.
- F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

#### 1.27 RECORD DRAWINGS

- A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.

- B. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Items to be indicated include but are not limited to:
1. Dimensional change
  2. Revision to drawing detail
  3. Location and depth of underground utility
  4. Revision to pipe routing
  5. Revision to electrical circuitry
  6. Actual equipment location
  7. Pipe size and routing
  8. Location of concealed internal utility
  9. Changes made by Change Order
  10. Details not on original Contract Drawing
  11. Information on concealed elements which would be difficult to identify or measure later
- C. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
- D. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
- E. Note related Change Order numbers where applicable.
- F. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
- G. Final record documents shall be prepared in the latest electronic version and on USB Flash drive of all drawings and a clean set of reproducible paper copies shall be turned over to the Owner at the completion of the work.

#### 1.28 WARRANTIES AND BONDS

- A. The following general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers' standard warranties on products and special warranties are to be included:
1. General close-out requirements included in Division 01.

2. Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of Divisions-02 through -50.
  3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

#### 1.29 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.
- H. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit

properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.

- I. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.
  - 1. Refer to individual Sections of Divisions-02 through -50 for specific content requirements, and particular requirements for submittal of special warranties.
- J. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- K. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
  - 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
  - 2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.
  - 3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

### 1.30 GUARANTEES

- A. The Contractor shall guarantee all material and installation quality under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner. During this guarantee period, all defects developing through faulty equipment, materials or installation quality shall be corrected or replaced immediately by this Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.
- B. Contractor shall provide name, address, and phone number of all contractors and subcontractors and associated equipment they provided.

### 1.31 PROJECT CLOSE-OUT

- A. Submit specific warranties, quality bonds, maintenance agreements, final certifications and similar documents in accordance with Division 01.
- B. Deliver tools, spare parts, extra stock, and similar items.
- C. Complete start-up testing of systems, including measuring and documenting all required startup checklist requirements documented in installation and maintenance instructions by the equipment manufacturer, and instruction of the Owner's operating and

maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

- D. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
- E. Field Observation Procedures: On receipt of a request for an Engineers Field Observation, the Engineer will advise the Contractor of unfulfilled requirements. The Engineer will advise the Contractor of construction that must be completed or corrected before the certificate will be issued. Contractor shall submit written response to each corrective item including specific photos prior to final Engineering inspection.
  - 1. The Engineer will repeat the Field Observation when requested and assured that the Work has been substantially completed.
  - 2. Results of the completed list of unfulfilled items will form the basis of requirements for final acceptance.

END OF SECTION

**Electronic Drawing File Release Form**

DELIVERY OF ELECTRONIC FILES FOR: \_\_\_\_\_  
Project Name

In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by the Design Professional, the Client covenants and agrees that all such drawings and data are instruments of service of the Design Professional, who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

The Client further agrees not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Client agrees to waive all claims against the Design Professional resulting in any way from any unauthorized changes or reuse of the drawings and data for any other project by anyone other than the Design Professional.

In addition, the Client agrees, to the fullest extent permitted by law, to indemnify and hold the Design Professional harmless from any damage, liability or cost, including reasonable attorneys' fees and costs of defense, arising from any changes made by anyone other than the Design Professional or from any reuse of the drawings and data without the prior written consent of the Design Professional.

Under no circumstances shall transfer of the drawings and other instruments of service on electronic media for use by the Client be deemed a sale by the Design Professional, and the Design Professional makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.

\_\_\_\_\_  
Client's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company - Title

\_\_\_\_\_  
Architects' Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Firm - Title

\_\_\_\_\_  
Owner's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company - Title

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Stack sleeves fittings.
- C. Sleeve-seal systems.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07 – Thermal and Moisture Protection.
- C. Division 09 – Finishes.
- D. Division 22 – General-Duty Valves for Plumbing Piping.
- E. Division 22 – Identification for Plumbing Piping and Equipment
- F. Division 22 – Plumbing Insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

1.4 SUBMITTALS

- A. See Division 01 - General Requirements, for submittal procedures.

- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years experience.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

#### 1.7 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.1 SLEEVES

- A. Materials
  - 1. Cast-Iron Pipe Sleeve: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated
  - 2. Galvanized Steel Pipe Sleeve: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
  - 3. Galvanized-Steel Sheet Sleeve: 0.0239-inch thickness; round tube closed with longitudinal joint.

#### 2.2 STACK SLEEVE FITTINGS

- A. Manufacturers
  - 1. Zurn Industries, LLC
  - 2. Jay R. Smith Mfg. Co.
  - 3. MIFAB, Inc.
  - 4. Josam
  - 5. Substitutions: See Division - 01 General Requirements.
- B. Stack Sleeve Fitting
  - 1. Galvanized cast iron sleeve with integral flashing flange. Provide underdeck clamp where required.

## 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
  - 1. Flexicraft Industries; PipeSeal.
  - 2. Metraflex
  - 3. Link-Seal
  - 4. Substitutions: See Division - 01 General Requirements.
  
- B. Modular/Mechanical Seal:
  - 1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
  - 2. Provide watertight seal between pipe and wall/casing opening.
  - 3. Elastomer element size and material in accordance with manufacturer's recommendations.
  - 4. Glass reinforced plastic pressure end plates.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Lay out penetration and sleeve openings in advance, to permit provision in work. Coordinate work with architectural and structural work. Set sleeves in forms before concrete is poured. Provide remedial work where sleeves are omitted or improperly placed. Remedial work includes core drilling (see requirements below) for penetrations if walls are poured, or otherwise constructed, without required sleeves. Provide core drilling (see requirements below) of existing construction. Do not penetrate structural members without Structural Engineer's/Architect's written approval.
  
- B. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  
- C. Sleeve installation shall meet NFPA-101 requirements, UL rated assemblies requirements, and materials requirements of these specifications. Submit a list of the UL listed details that the Contractor intends on using on this project in all rated assemblies.
  
- D. Sleeves that penetrate outside walls, basement slabs, footings and beams shall be waterproof. Sleeves that penetrate floors shall be waterproof.
  
- E. Where pipes passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.
  
- F. Identify unused sleeves and slots for future installation. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of pipe. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes.
  
- G. Do not support piping risers or conduit on sleeves.
  
- H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.

- I. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements. Verify final equipment locations for roughing-in.
- J. Structural Considerations: Do not penetrate building structural members unless indicated.

### 3.2 APPLICATIONS

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls Above Grade:
    - a. Cast-iron pipe sleeves or galvanized-steel pipe sleeves.
  - 2. Exterior Concrete Walls Below Grade:
    - a. Cast-iron pipe sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.
    - b. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Cast-iron pipe sleeves with sleeve-seal system, or galvanized-steel-pipe sleeves with sleeve-seal system.
    - b. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. Galvanized-steel-pipe sleeves, or stack sleeve fittings
  - 5. Interior Partitions:
    - a. Cast iron pipe sleeves, galvanized-steel-pipe sleeves, or galvanized-steel-sheet sleeves.
  - 6. Floors with membrane waterproofing:
    - a. Stack sleeve fittings.

### 3.3 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.

- E. Sleeves for insulated pipe in non-fire rated construction shall accommodate continuous insulation without compression.
- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified Division 07.

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
- B. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
- C. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07.
- D. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
- E. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- F. Using grout, seal the space around outside of stack-sleeve fittings.
- G. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 – Thermal and Moisture Protection.

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size.
- C. Position piping in center of sleeve.
- D. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve.
- E. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.
- F. Install in accordance with manufacturer's recommendations.

### 3.4 CORE DRILLING

- A. Core drilling shall be avoided in new construction. Set sleeves prior to installation of structure for passage of pipes, conduit and ducts. Where core drilling is unavoidable (e.g. when individual sleeves are not installed or incorrectly located) or required by renovation projects, locate required openings prior to coring and submit locations for review.
- B. Coordinate openings with other Divisions.

- C. Do not disturb existing systems. Protect areas from damage.
- D. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.

3.5 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section Includes:
  - 1. Gate valves.
  - 2. Ball valves.
  - 3. Butterfly valves.
  - 4. Check valves.
  - 5. Pressure reducing.
  - 6. Pressure relief.
  - 7. Strainers.
  - 8. Balancing valves.
  - 9. Reduced pressure backflow preventers.
  - 10. Thermostatic mixing valves.
- B. Related Sections:
  - 1. Division 01 – General Requirements.
  - 2. Division 22 – General Conditions for Plumbing Trades
  - 3. Division 22 – Plumbing Piping
  - 4. Division 22 – Plumbing Insulation

1.3 REFERENCES

- A. ASTM International:
  - 1. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 2. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.
- B. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP 67 - Butterfly Valves.
  - 2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
  - 3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  - 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
  - 5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
  - 6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- C. Safe Drinking Water Act:

1. SDWA 1417 - Reduction of Lead in Drinking Water.

#### 1.4 SUBMITTALS

- A. Division 01 – General Requirements: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - General Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

#### 1.6 QUALITY ASSURANCE

- A. For drinking water service, provide valves complying with NSF 61.
- B. All valve manufacturers shall demonstrate that valve products have been certified per NSF/ANSI Standard 372.
- C. All valves installed on the domestic water system shall have labeling of lead content engraved on the valve body.
- D. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by Victaulic or an Engineer Approved Equal

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - General Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.

## 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements: Environmental conditions affecting products on site.
- B. Do not install valves underground when bedding is wet or frozen.

## 1.10 WARRANTY

- A. Division 01 – General Requirements: Requirements for warranties.
- B. Furnish one year manufacturer warranty for valves excluding packing.

## 1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish one packing kits for each size valve.

## PART 2 PRODUCTS

### 2.1 GATE VALVES

- A. Manufacturers:
  - 1. Apollo
  - 2. Milwaukee Valve Co.
  - 3. NIBCO, Inc.
  - 4. American Valve Co.
  - 5. Watts
  - 6. Division 01 – General Requirements
- B. 2 inches and Smaller: MSS SP 80, Class 300, bronze body, bronze trim, lead free, threaded bonnet, non-rising stem, hand-wheel, inside screw, solid wedge disc, solder ends, Milwaukee Valve Company Model # UP115.
- C. 2 1/2 inches and Larger: MSS SP 70, Class 175, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends, Milwaukee Valve Company F-2885-FP. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

### 2.2 BALL VALVES

- A. Manufacturers:
  - 1. Apollo
  - 2. Milwaukee Valve Co.
  - 3. NIBCO, Inc.
  - 4. American Valve Co.
  - 5. Watts
  - 6. Division 01 – General Requirements
- B. 2 inches and Smaller: MSS SP 110, 600 psi WOG, two piece bronze body, lead free, type 316 stainless steel ball, full port, teflon seats, stainless steel blow-out proof stem, solder ends with lever handle, Milwaukee Valve Company Model #UPBA450S.

## 2.3 CHECK VALVES

- A. Horizontal Swing Check Valves:
  - 1. Manufacturers:
    - a. Apollo
    - b. Milwaukee Valve Co.
    - c. NIBCO, Inc.
    - d. American Valve Co.
    - e. Watts
    - f. Division 01 – General Requirements
  - 2. 2 inches and Smaller: MSS SP 80, Class 300, bronze body and cap, bronze seat, brass disc, solder ends, Milwaukee Valve Co. Model # 1509.
- B. Spring Loaded Check Valves:
  - 1. Manufacturers:
    - a. Apollo
    - b. Milwaukee Valve Company
    - c. NIBCO, Inc.
    - d. American Valve Co.
    - e. Watts
    - f. Division 01 – General Requirements
  - 2. 2-1/2 inches and Larger: MSS SP 125, Class 125, lead free, wafer style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends, Nibco Model # F-910-LF.

## 2.4 WATER PRESSURE REDUCING VALVES

- A. Watts Model 223 or approved equal:
  - 1. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, threaded ends, with strainer.
  - 2. Over 2 Inches (50 mm): Cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged, with strainer, MSS-SP-80.

## 2.5 TEMPERATURE AND PRESSURE RELIEF VALVES

- A. Watts Model 40, 140, N240, 340 or approved equal:
  - 1. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

## 2.6 STRAINERS

- A. Watts series 77 or approved equal:
  - 1. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
  - 2. Size 2-1/2 inch to 4 inch: Flanged cast iron body, Class 125 for 200 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

## 2.7 BALANCING VALVES

- A. Bell & Gossett CB Series or approved equal:

1. Construction: Brass or bronze body with union on inlet, temperature and pressure test plug on inlet and outlet.
2. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

## 2.8 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013, AWWA C506; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; test cocks, Watts 909 or equal.

## 2.9 THERMOSTATIC MIXING VALVES

A. Manufacturers:

1. Lawler
2. Leonard
3. Powers
4. Watts
5. Symmons
6. Division 01 – General Requirements

B. Accessories:

1. Check valves on inlets.
2. Volume control shut-off valve on outlet.
3. Stem thermometer on outlet.
4. Strainer stop checks on inlets.

- C. Temp control thermostatic controller with swivel action check stops, removable cartridge with strainer, stainless steel piston and liquid filled motor with bellows mounted out of water, rough brass finish

- D. Valve body: lead free bronze or brass.

- E. Cabinet: 16 gage (1.5 mm) prime coated steel, for recessed and surface mounting with keyed lock.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Division 01 – General Requirements: Verification of existing conditions before starting work.
- B. Verify piping system is ready for valve installation.

### 3.2 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

- C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Division 08.
- F. Refer to Division 22 for pipe hangers.
- G. Refer to Division 22 for insulation requirements for valves.
- H. Refer to Division 22 for piping materials applying to various system types.

### 3.3 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install ball or butterfly valves for throttling, bypass, or manual flow control services.
- D. Install spring loaded check valves on discharge of water pumps.
- E. Install lever and spring check valves on discharge of pumps in pumped sanitary piping.
- F. Install lug or grooved end butterfly valves adjacent to equipment when functioning to isolate equipment.
- G. Install balancing valves at the remote part of the domestic hot water return system. Valve size shall be minimum of 3/4-inch
- H. Provide line sized isolation valves on all domestic water branches greater than 3/4" when more than two fixtures are supplied.
- I. Install ball valves in domestic water systems for shut-off service.
- J. Install butterfly valves in domestic water systems for throttling service.

END OF SECTION

## SECTION 22 05 29

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

#### PART 1 GENERAL

##### 1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe hangers and supports.
  - 2. Hanger rods.
  - 3. Inserts.
  - 4. Flashing.
  - 5. Formed steel channel.
  - 6. Equipment bases and supports.
- B. Related Sections:
  - 1. Division 03 – Concrete Section
  - 2. Division 07 – Thermal and Moisture Protection
  - 3. Division 09 – Finishes
  - 4. Division 22 – General Conditions for Plumbing Trades
  - 5. Division 22 – Plumbing Piping

##### 1.3 REFERENCES

- A. American Society of Mechanical Engineers:
  - 1. ASME B31.1 - Power Piping.
  - 2. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
  - 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
  - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
  - 3. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems
  - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
  - 5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.

- D. FM Global:
  - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
- F. Underwriters Laboratories Inc.:
  - 1. UL 263 - Fire Tests of Building Construction and Materials.
  - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
  - 3. UL 1479 - Fire Tests of Penetration Firestops.
  - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
  - 5. UL - Fire Resistance Directory.

#### 1.4 SUBMITTALS

- A. Division 01 - General Requirements
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data: Submit manufacturers catalog data including load capacity.
- D. Manufacturer's Installation Instructions: Submit special procedures and assembly of components.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years of experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years of experience.

#### 1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - General Requirements.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01- General Requirements.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

#### 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.10 WARRANTY

- A. Division 01 - General Requirements.

### PART 2 PRODUCTS

#### 2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
  - 1. Globe Pipe Hanger Products Inc.
  - 2. Anvil International
  - 3. Empire Industries
  - 4. Hilti Inc.
  - 5. Substitutions: Division 01- General Requirements
- B. Plumbing Piping - DWV:
  - 1. Conform to ASME B31.9, ASTM F708, or MSS SP 58.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring.
  - 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
  - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
  - 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
  - 7. Vertical Support: Steel riser clamp.
  - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- C. Plumbing Piping - Water:
  - 1. Conform to ASME B31.9, ASTM F708, or MSS SP 58.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring.
  - 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
  - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
  - 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
  - 7. Vertical Support: Steel riser clamp.
  - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 9. Copper Pipe Support: Copper-plated, Carbon-steel ring.

## 2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded as required by application.

## 2.3 INSERTS

- A. Manufacturers:
1. Hilti Inc.
  2. Anvil International
  3. Eaton
  4. 3M
  5. Substitutions: Refer to Division 01 – General Requirements.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.4 FLASHING

- A. Refer to Division 07 - Thermal and Moisture Protection

## 2.5 SLEEVES

- A. Manufacturers:
1. Flexicraft Industries; Pipe Wall Sleeve
  2. Metraflex; Pipe Wall Sleeve
  3. CCI Pipeline; Pipe Wall Sleeve
  4. GPT – Centuryline Sleeve Series
  5. Substitutions: See Division 01 - General Requirements and 22 04 00 – General Requirements.
- B. Vertical Piping:
1. Sleeve Length: 1 inch above finished floor.
  2. Provide sealant for watertight joint.
  3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
  4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- C. Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. Pipe Passing Through Below Grade or Exterior Walls:
1. Anchored Sleeve - Zinc coated or cast iron pipe.
  2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Clearances:
1. Provide allowance for insulated piping.
  2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.

- 3. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814-13A in accordance with Division 07 Thermal and Moisture Protection to prevent the spread of fire, smoke, and gases.
- F. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.
- G. Sleeves for Pipes through Non-fire Rated Walls, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- H. Sealant: refer to Division 07 Thermal and Moisture Protection.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
  - 1. Thunderline Link-Seal, Inc.
  - 2. NMP Corporation
  - 3. Fernco
  - 4. BWM
  - 5. Substitutions: Refer to Division 01 – General Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- C. Provide NSF 61 certified assembly when used in potable water storage tank applications.

## 2.7 FORMED STEEL CHANNEL

- A. Manufacturers:
  - 1. Allied Tube & Conduit Corp.
  - 2. B-Line Systems
  - 3. Midland Ross Corporation, Electrical Products Division
  - 4. Unistrut Corp.
  - 5. Substitutions: Refer to Division 01 – General Requirements
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Division 01 - General Requirements.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

### 3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

### 3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

### 3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, or MSS SP 58.
- B. Support horizontal piping as scheduled.
- C. All pipe hangers and supports shall be sized in accordance with the manufacturer's guidelines to support the piping based on final layout coordinated by the contractor.
- D. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- E. Place hangers within 12 inches of each horizontal elbow.
- F. Use hangers with 1-1/2 inch minimum vertical adjustment.
- G. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- H. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- I. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

- J. Support riser piping independently of connected horizontal piping.
- K. Provide copper plated hangers and supports for copper piping.
- L. Design hangers for pipe movement without disengagement of supported pipe.
- M. Prime coat exposed steel hangers and supports. [Refer to Section 09 90 00.] Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Division 22 for supplemental angles, channels and formed steel supports to support piping, ductwork, equipment, etc. from building's structure. Piping, ductwork, equipment, etc. shall not be supported from the roof deck.

### 3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Division 01
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members, formed steel channel and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

### 3.6 INSTALLATION - FLASHING

- A. Refer to Division 08
- B. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- C. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- D. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- E. Seal floors, showers, and mop sink drains watertight to adjacent materials.
- F. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.7 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.

- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with stuffing, and firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel, or stainless steel escutcheons at finished surfaces.

3.8 FIELD QUALITY CONTROL

- A. Refer to Division 01 - Quality Requirements and Execution and Closeout Requirements.

3.9 CLEANING

- A. Refer to Division 01 - Execution and Closeout Requirements:

3.10 PROTECTION OF FINISHED WORK

- A. Refer to Division 01 Execution and Closeout Requirements

3.11 SCHEDULES

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
Brass	6	1/2
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10 foot length of pipe	10	5/8
CPVC, 1 inch and smaller	3	1/2
CPVC, 1-1/4 inches and larger	4	1/2
Copper Tube and Pipe, 1-1/4 inches and smaller	6	1/2
Copper Tube and Pipe, 1-1/2 inches and larger	10	1/2
PEX	2	1/2
PVC 1 1/2 inch and smaller	3	3/8
PVC 2 inch and larger	4	3/8
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Underground pipe warning tape
- E. Ceiling grid markers

1.3 RELATED REQUIREMENTS

- A. Division 09 - Finishes: Identification painting.

1.4 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers:
  - 1. ASME A13.1 - Scheme for the Identification of Piping Systems
- B. American Society for Testing Materials
  - 1. ASTM D709 - Standard Specification for Laminated Thermosetting Materials

1.5 SUBMITTALS

- A. See Division 01 – General Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers catalog literature for each product required.
- C. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- D. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

- F. Project Record Documents: Record actual locations of tagged valves.

## 1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Identification products shall be provided by the following manufacturers:
  1. Craftmark Pipe Markers
  2. Brimar Industries, Inc.
  3. Kolbi Pipe Marker Co.
  4. Seton Identification Products
  5. Substitutions: See Division 01 - General Requirements.
- B. All identification products shall be by a single manufacturer

### 2.2 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
  1. Letter Color: White.
  2. Letter Height: 1/4 inch.
  3. Background Color: Black.
  4. Plastic: Conform to ASTM D709.

### 2.3 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

### 2.4 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

## 2.5 UNDERGROUND PIPE WARNING TAPE

- A. Detectable Underground Warning Tape: Bright colored continuously printed, 2 mil clear film laminated to ½ mil Aluminum Foil Center Core. Suitable for direct burial. Designed for detectability by non-ferrous locator. Minimum widths as follows:
  - 1. 2" width for burial depths of up to 12"
  - 2. 3" width for burial depth of 12" to 18"
  - 3. 6" width for burial depth of 18" to 24"
- B. Provide with a continuous printed message similar to "Caution Water Line Buried Below".

## 2.6 CEILING GRID MARKERS

- A. Description: 10 mil self-stick vinyl -7/8" diameter markers. Color coded.
- B. Color code as follows:
  - 1. Plumbing Valves: Green.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 09 – Finishes, for stencil painting.

### 3.2 INSTALLATION

- A. Install identifying devices after completion of testing and installation of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion.
- C. Install tags using corrosion resistant chain. Number tags consecutively by location.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install detectable underground warning tape 6 to 8 inches below finished grade, directly above buried pipe.
- G. Install piping identification on medical gas systems. Refer to Section 22 60 13.

### 3.3 APPLICATIONS

- A. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- B. Identify control panels and major control components outside panels with plastic nameplates.

- C. Identify valves in main and branch piping with tags.
- D. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers.
  - 1. Identify service, and flow direction.
  - 2. Install in clear view and align with axis of piping.
  - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops.
  - 4. For concealed piping identification shall be located not to exceed 10 feet.
  - 5. Locate identification adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- E. Identify underground utilities with detectable underground warning tape.
- F. Provide ceiling grid markers to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 SUMMARY

- A. GENERAL PROVISIONS – FILED SUB-BID REQUIRED
  - 1. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.
- B. Section Includes:
  - 1. Plumbing piping insulation, jackets and accessories.
- C. Related Sections:
  - 1. Division 01 General Requirements
  - 2. Division 07 - Firestopping
  - 3. Division 09 - Finishes

1.2 REFERENCES (follow the most currently adopted amended version)

- A. ASTM International:
  - 1. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless
  - 2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - 3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - 4. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
  - 5. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  - 6. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
  - 7. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - 8. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
  - 9. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 10. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - 11. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  - 12. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
  - 13. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

14. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
15. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
16. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
17. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
18. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
19. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
20. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation.
21. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber.
22. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
23. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
24. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
25. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
26. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
27. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Underwriters Laboratories Inc.:

1. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Division 01 – General Requirements
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and installation standards will be achieved.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- B. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

- D. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping. Store all insulation materials in a clean, dry environment.

#### 1.6 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

#### 1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.8 WARRANTY

- A. Division 01 - Execution and Closeout Requirements.

#### 1.9 SCHEDULING

- A. Schedule insulation application after pressure and leak testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

### PART 2 PRODUCTS

#### 2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

#### 2.2 MANUFACTURER

- A. Pre-Molded Glass Fiber (PGF):
  1. Johns Manville Corporation – Microlok HP Pipe Insulation
  2. CertainTeed Corporation - Crimpwrap
  3. Knauf Insulation – Earthwool
  4. Owens Corning Corporation; SSL II w ASJ:
  5. Substitutions: Refer to Division 01 – General Requirements.
- B. Manufacturers for PVC Jacketing (PVC):
  1. Johns Manville - Zeston

2. P.I.C. Plastics Inc.
3. Proto Corporation
4. Substitutions: Division 01.

### 2.3 PIPE INSULATION

- A. Pre-Molded Glass Fiber (PGF) Pipe Insulation:
1. ASTM C547 and ASTM C795, rigid molded, noncombustible with jacket.
  2. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
  3. Maximum Service Temperature: 850 degrees F.
  4. Maximum Moisture Absorption: 0.2 percent by volume.
  5. Vapor Barrier Jacket: Outer film layer, kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96 of 0.02 perm-inches.
  6. Vapor Barrier Lap Adhesive: Compatible with insulation.

### 2.4 JACKETS

- A. Polyvinyl-chloride Plastic Pipe Jacket (PVC):
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: 0 degrees F.
    - b. Maximum Service Temperature: 150 degrees F.
    - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96
    - d. Thickness: 10 mil.
    - e. Connections: Brush on welding adhesive.
  2. Covering Adhesive Mastic: Compatible with insulation.

### 2.5 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: hydrous calcium silicate. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self-adhesive closure. Thickness to match pipe insulation.
- F. Valve insulation Wraps: White, noncombustible, conforming to ASTM E 84. Match insulation thickness to pipe size. Valve covers shall be easily removable.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Protect insulation from exposure to moisture prior to and after installation. All insulation other than flexible elastomeric that becomes wet shall be replaced at no cost to the project.

- B. Verify that piping and equipment has been tested before applying insulation materials.
- C. Verify that piping and equipment surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION - PIPING

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Piping and fittings exposed to view: Provide with PVC Plastic pipe jacketing and fittings for additional protection. Locate insulation and cover seams in least visible locations.
- D. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 for penetrations of assemblies with fire resistance rating greater than one hour.
- E. Insulated pipes conveying fluids below ambient temperature:
  - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
  - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
- F. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- G. Pre-molded Glass Fiber (PFG) insulated pipes conveying fluids above or below ambient temperature:
  - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with PVC fitting covers.
- H. For hot piping conveying fluids, insulate flanges and unions at equipment.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 – Thermal and Moisture Protection for penetrations of assemblies with fire resistance rating greater than one hour.
- J. Buried Piping: Provide closed cell elastomeric insulation with all-purpose service jacket with self-sealing lap.
- K. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

L. Prepare pipe insulation for finish painting. Refer to Division 09.

### 3.3 PIPE INSULATION SCHEDULE

- A. Provide insulation materials and thicknesses scheduled for each system type and pressure/temperature range. If more than one material is listed for a system, selection from materials listed is Division 22 option.
- B. Insulation for pre-insulated piping shall meet all specified requirements.
- C. Insulation thickness shall be coordinated with heat trace manufacturers' installation instructions. Listed sizes on schedule shall be used as minimum sizes only.

Domestic Hot Water Supply and Recirculation Systems				
Insulation Type	Pipe Size (inch)	Indoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
Pre-Molded Glass Fiber (PFG)	1-1/4 inches and smaller	1.0	ASJ-SSL	Indoor: PVC for exposed piping finished space and mechanical rooms.
	1-1/2 inches and larger	1.5		

Domestic Cold Water Supply Systems				
Insulation Type	Pipe Size (inch)	Indoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
Pre-Molded Glass Fiber (PFG)	1-1/4 inches and smaller	0.5	ASJ-SSL	Indoor: PVC for exposed piping finished space and mechanical rooms.
	1-1/2 inches and larger	1.0		

END OF SECTION

SECTION 22 10 05

PLUMBING PIPING

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
  - 1. Sanitary sewer.
  - 2. Domestic water.
  - 3. Flanges, unions, and couplings.

1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Division 08 – Openings.
- C. Division 07 - Thermal and Moisture Protection
- D. Division 09 - Finishes.
- E. Section 22 0400 – General Conditions for Plumbing Trades.
- F. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.
- G. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- H. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- I. Section 22 0719 - Plumbing Piping Insulation.
- J. Division 26 – Electrical: Electrical characteristics and wiring connections.
- K. Division 31 - Earthwork
- L. Division 33 - Utilities.

1.4 REFERENCE STANDARDS – Most Currently adopted versions and amendments for the location of the project.

- A. American National Standards Institute
  - 1. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; and addenda A&B.

2. ANSI Z223.1 - National Fuel Gas Code.
- B. American Society of Mechanical Engineers
1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  2. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
  3. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250.
  4. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  5. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  6. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
  7. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
  8. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
  9. ASME B31.9 - Building Services Piping.
  10. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers.
  11. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications.
- C. American Society of Sanitary Engineering
1. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems.
- D. American Society for Testing and Materials
1. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
  2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  3. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
  4. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  5. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  6. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  7. ASTM B32 - Standard Specification for Solder Metal.
  8. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
  9. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
  10. ASTM B68 - Standard Specification for Seamless Copper Tube, Bright Annealed.
  11. ASTM B75 - Standard Specification for Seamless Copper Tube.
  12. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
  13. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.
  14. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
  15. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
  16. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  17. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
  18. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  19. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

20. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
  21. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  22. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
  23. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
  24. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
  25. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
  26. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
  27. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
  28. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  29. ASTM D2846 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
  30. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
  31. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  32. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
  33. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
  34. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
  35. ASTM F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
  36. ASTM F442 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
  37. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  38. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
  39. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
  40. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
  41. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
  42. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
  43. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe;.
  44. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe.
  45. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
- E. American Welding Society
1. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

2. AWS D1.1 - Structural Welding Code - Steel;.
- F. American Water Works Association
1. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
  2. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.
  3. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  4. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.
  5. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
  6. AWWA C606 - Grooved and Shouldered Joints.
  7. AWWA C651 - Disinfecting Water Mains.
  8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Transmission and Distribution; 2016.
  9. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service.
- G. Cast Iron Soil Pipe Institute
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
  2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- H. International Code Council
1. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Element.
  2. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
  3. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.
  4. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- I. Manufacturers Standardization Society
1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
  2. MSS SP-67 - Butterfly Valves.
  3. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
  4. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  5. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 20DA.  
MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
  6. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.
  7. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- J. National Sanitation Foundation
1. NSF 61 - Drinking Water System Components - Health Effects.
  2. NSF 372 - Drinking Water System Components - Lead Content.
- K. Plastic Pipe Institute
1. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe.

## 1.5 SUBMITTALS

- A. See Division 01- General Requirements
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Welder Certificate: Include welder's certification of compliance with ASME BPVC-IX.
- D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- E. Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.
- F. Project Record Documents: Record actual locations of valves.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Division 01 -General Requirements.
  - 2. Valve Repacking Kits: One for each type and size of valve.

## 1.6 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## 1.8 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux, that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

### 2.2 SANITARY SEWER PIPING, BURIED

- A. Cast Iron Soil Pipe: ASTM A74, extra heavy weight, bell and spigot or plain ends.
  - 1. Fittings: Cast iron, ASTM A74.
  - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

### 2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
  - 1. Fittings: Cast iron, ASTM A74.
  - 2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum as required for urinal waste.
- B. Cast Iron Pipe: CISPI 301, hub-less, service weight.
  - 1. Fittings: Cast iron, CISPI 301.
  - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. Copper Tube: ASTM B306, DWV.
  - 1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, solvent.
  - 2. Joints: ASTM B32, alloy Sn50 solder.

### 2.4 DOMESTIC WATER PIPING, BURIED

- A. Copper Pipe: ASTM B42, hard drawn.
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
  - 2. Joints: ASTM B32, alloy Sn95 solder.
  - 3. Joints: AWS A5.8M/A5.8, BCuP copper/silver braze.

### 2.5 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88, Type K (A).
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - 2. Joints: ASTM B32, alloy Sn95 solder.
  - 3. Joints: Grooved mechanical couplings.
  - 4. Mechanical Press Sealed Fittings: Double pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non-toxic synthetic rubber sealing elements.
    - a. Manufacturers:
      - 1) Mueller Streamline Co (Mass approved manufacturer)
      - 2) Oatey Company (Mass approved manufacturer)
      - 3) Cambridge Lee Industries (Mass approved manufacturer)
      - 4) JM Eagle (Mass approved manufacturer)
      - 5) Viega LLC
      - 6) Substitutions: Division 01- General Requirements.

## 2.6 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:
  - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
  - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
  
- B. Flanges for Pipe Size Over 1 Inch:
  - 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
  - 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
  
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier are required where two dissimilar metal products are connected within a system.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Division 22.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Division 22.
- G. Provide access where valves and fittings are not exposed.
  - 1. Coordinate size and location of access doors with Division 08.
- H. Establish elevations of buried piping outside the building to ensure not less than the local area's frost depth of cover.

- I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly and a minimum of 25 feet from an air intake; refer to Division 08 Openings.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Provide support for utility meters in accordance with requirements of utility companies.
- L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
  - 1. Painting of interior plumbing systems and components are specified in Division 09 - Finishes.
  - 2. Painting of exterior plumbing systems and components are specified in Division 09 - Finishes.
- M. Excavate in accordance with Division 31- Earthwork requirements.
- N. Backfill in accordance with Division 31 – Earthwork requirements
- O. Install bell and spigot pipe with bell end upstream.
- P. Install water piping to ASME B31.9.
- Q. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- R. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.4 TOLERANCES

- A. Sanitary Drainage Piping: slope to sanitary drain at minimum of 1/4" per foot for horizontal piping 3" and smaller. Slope sanitary drain 1/8" per foot for horizontal piping larger than 3 inches.

### 3.5 SYSTEM FLUSHING

- A. The following system flushing criteria shall apply to all domestic water piping systems inclusive of hot water, cold water and hot water recirculation.
- B. Upon completion of installation of piping, and prior to disinfection, flush the piping systems with clean, potable water until dirty water does not appear at the points of outlet.
- C. Remove strainers and flow restrictors from fixtures prior to flushing and reinstall after flushing is complete
- D. Mixing valves located at fixtures shall not be installed until after flushing is complete. Provide temporary bypass connections as required.
- E. Provide isolation and temporary bypass piping for water heaters, expansion tanks, and other equipment.
- F. Run fixtures simultaneously for a minimum of 30 minutes or until no debris is evident.

- G. Flushing shall be considered satisfactory when no debris is evident after running water through a number 80 mesh screen.
- H. Contractor to notify engineer and owner a minimum of 72 hours before performing flushing.
- I. Once system has been successfully flushed, contractor shall provide a report to engineer documenting flushing procedure and results.

### 3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

### 3.7 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
  - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
  - 2. Provide 18 gage, 0.0478 inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Commercial Electric Water Heaters
- B. Inline Circulator Pumps
- C. Submersible sump pumps

1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.4 REFERENCE STANDARDS See Division 01 - General Requirements

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.
- D. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous.
- E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels.
- F. CSA P.3 - Testing Method for Measuring Energy Consumption and Determining Efficiencies of Gas-Fired Storage Water Heaters; 2004 (Reaffirmed 2015).
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. NEMA MG 1 - Motors and Generators.
- I. NFPA 31 - Standard for the Installation of Oil Burning Equipment.

- J. NFPA 70 - National Electrical Code.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### 1.6 SUBMITTALS

- A. See Division 01 - Administrative Requirements, for submittals procedures.
- B. Product Data:
  - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
  - 2. Indicate pump type, capacity, power requirements.
  - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
  - 4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
  - 1. Indicate heat exchanger dimensions, size of tappings, and performance data.
  - 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. Manufacturer's Instructions.
- E. Project Record Documents: Record actual locations of components.
- F. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- H. Project Record Documents: Record actual locations of components.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Division 01 - Product Requirements, for additional provisions.
  - 2. Extra Pump Seals: One of each type and size.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
  - 1. Water Heaters: NSF approved.
  - 2. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1, as applicable, in addition to requirements specified elsewhere.
  - 3. Electric Water Heaters: UL listed and labeled to UL 174.
  - 4. Oil-Fired Water Heaters: To NFPA 31.

5. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
  6. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
  7. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

## 1.9 WARRANTY

- A. See Division 01 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

## PART 2 PRODUCTS

### 2.1 WATER HEATERS

- A. Manufacturers:
1. Rheem Manufacturing Company
  2. A.O. Smith Water Products Co
  3. State Industries
  4. Substitutions: See Division 01 - Product Requirements.
- B. Commercial Electric:
1. Performance: Refer to schedule on Plumbing Drawings.
  2. Type: Factory-assembled and wired, electric, vertical storage.
  3. Maximum Working Pressure: 150 psig.
  4. Electrical Characteristics:
    - a. 120 volts, single phase, 60 Hz.
  5. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
  6. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
  7. Accessories:
    - a. Water Connections: Brass.
    - b. Dip Tube: Brass.
    - c. Drain valve.
    - d. Anode: Magnesium.
    - e. Temperature and Pressure Relief Valve: ASME labeled.
  8. Tank: Welded steel ASME labeled pressure vessel; glass lining, mounted on steel channel base with lifting lugs, insulated with 2 inch glass fiber; enclosed with 16 gage, 0.0598 inch steel jacket; baked enamel finish.

9. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gages.
10. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

## 2.2 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
  1. Taco
  2. Armstrong Fluid Technology
  3. Bell & Gossett, a xylem brand
  4. Sterling SIHI GmbH
  5. Substitutions: See Division 01 - General Requirements.
- B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.
  1. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- G. Performance:
  - a. Refer to schedule on drawings.

## 2.3 SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
  1. Hydromatic
  2. Meyers
  3. Armstrong Fluid Technology
  4. Goulds Water Technology, a xylem brand
  5. Zoeller Company
  6. Substitutions: See Division 01 - General Requirements.
- B. Type: Submersible
- C. Casing: Cast iron pump body and oil filled motor chamber.
- D. Impeller: Cast iron; open non-clog, stainless steel shaft.
- E. Bearings: heavy duty, single row ball bearings.
- F. Accessories: Oil resistant 20 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

- G. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.
- H. Controls: Integral diaphragm type level controls with separate liquid level control high level alarm.
- I. Controls: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electro mechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn. Provide mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm.
- J. Performance:
  - 1. Refer to schedules on Plumbing Drawings.

## 2.4 ELECTRICAL WORK

- A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.
- B. Electrical characteristics to be as specified or indicated.
- C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping work to achieve operating system.
- C. Domestic Water Heater:
  - 1. Maintain manufacturer's recommended clearances around and over water heaters.
  - 2. Install water heater on concrete housekeeping pad, minimum 5-1/2 inches high and 6 inches larger than water heater base on each side. Refer to division 03.
  - 3. Connect domestic hot water domestic cold water piping to supply and return water heater connections.
  - 4. Install the following piping accessories.
  - 5. On supply: Thermometer well and thermometer, Strainer, Pressure gage, Shutoff valve.
  - 6. On return: Thermometer well and thermometer, Pressure gage, Shutoff valve.
  - 7. Install the following piping accessories on natural gas piping connections.
  - 8. Strainer, Pressure gage, Shutoff valve, Pressure reducing valve
  - 9. Install discharge piping from relief valves and drain valves to nearest floor drain.
  - 10. Install diaphragm expansion tank on water heater.

11. Install water heater trim and accessories furnished loose for field mounting.
12. Install electrical devices furnished loose for field mounting.
13. Install control wiring between water heater control panel and field mounted control devices.

D. Pumps:

1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
2. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
3. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
4. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
5. Align and verify alignment of base mounted pumps prior to start-up
6. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES AND SPECIALTIES

(Part of Filed Sub-Bid Section 220001 – Plumbing Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED DOCUMENTS

- A. Attention is directed to the following specifications sections, which are hereby made a part of this Section of the Specifications.
  - 1. Division 01 - General Requirements
  - 2. Division 07 – Thermal and Moisture Protection: Product requirements for caulking between fixtures and building components for placement by this section.
  - 3. Division 11 – Equipment.
  - 4. Division 12 – Furnishings.
  - 5. Division 22 – General Conditions for Plumbing Trades.
  - 6. Division 22 – Plumbing Insulation.
  - 7. Division 22 - Plumbing piping.
  - 8. Division 22 – General Duty Valves for Plumbing Piping.
  - 9. Division 22 – Hangers and Supports for Plumbing Piping and Equipment.
  - 10. Division 22 - Plumbing Equipment.
  - 11. Division 22 - Equipment Wiring Connections: Execution requirements for electric connections to sensor valves and faucets specified by this section.

1.3 SUMMARY

- A. Section includes the following plumbing fixtures:
  - 1. Drinking fountains.
  - 2. Electric water coolers
  - 3. Lavatories.

4. Sinks.
5. Urinals.
6. Water closets.

B. Section includes the following plumbing specialties:

1. Reduced Pressure Principal Backflow Preventers.
2. Double Check Valve Backflow Preventer Assemblies.
3. Cleanouts.
4. Expansion tanks.
5. Fixture supports.
6. Floor drains.
7. Floor sinks.
8. Hose bibs.
9. Indirect waste funnel.
10. Lavatory insulation kit.
11. Plumbing traps.
12. Recessed valve boxes.
13. Trap primers.
14. Wall hydrants.
15. Water hammer arrestors.
16. Stops

#### 1.4 REFERENCES

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- B. American National Standards Institute:
  1. ANSI 61 - Drinking Water System Components
  2. ANSI A112.21.1 - Floor Drains.
  3. ANSI A112.26.1 - Water Hammer Arrestors.
  4. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

5. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.
  6. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
- C. Air-Conditioning and Refrigeration Institute:
1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
- D. American Society of Mechanical Engineers:
1. ASME A112.6.3 – Floor and Trench Drains
  2. ASME A112.18.1 - Plumbing Supply Fittings.
  3. ASME A112.18.1M – Plumbing Fixture Fittings.
  4. ASME A112.18.2 – Plumbing Waste Fittings.
  5. ASME A112.19.1 - Enameled Cast Iron and Enameled Steel Plumbing Fixtures.
  6. ASME A112.19.2 - Ceramic Plumbing Fixtures.
  7. ASME A112.19.3 - Stainless Steel Plumbing Fixtures
  8. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures.
  9. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks.
  10. ASME A112.19.14 - Six-Liter Water Closets Equipped with Dual Flushing Device.
  11. ASME A112.19.19 Vitreous China Non-water Urinals
  12. ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
  13. ASME A112.36.2M – Cleanouts.
- E. American Society of Testing and Materials
1. ASTM A888-20 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
  2. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
  3. ASTM C1613-17 - Standard Specification for Precast Concrete Grease Interceptor Tanks
  4. ASTM F409 – Standard Specifications for Thermoplastic and Replaceable Plastic Tube and Tubular Fittings.
  5. ASTM F2649-14 - Standard Specification for Corrugated High Density Polyethylene (HDPE) Grease Interceptor Tanks

6. ASTM D-4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
- F. American Society of Safety Engineers
1. ASSE 1012, Performance Requirements For Backflow Preventers With An Intermediate Atmospheric Vent
  2. ASSE 1013, Performance Requirements for Reduced Pressure Principle Backflow Preventers
  3. ASSE 1016/ASME A112.1016/CSA B125.16-11, Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations
  4. ASSE 1017, Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
  5. ASSE 1062, Performance Requirements for Temperature Actuated Flow Reduction (TAFR) Valves for Individual Fixture Fittings
  6. ASSE 1066, Performance Requirements for Individual Pressure Balancing In-Line Valves for Individual Fixture Fittings
  7. ASSE 1069, Performance Requirements for Automatic Temperature Control Mixing Valves
  8. ASSE 1070/ASME A112.1070/CSA B125.70-15, Performance Requirements for Water Temperature Limiting Devices
  9. ASSE 1071, Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment
- G. American Society of Heating, Refrigeration and Air Conditioning Engineers:
1. ASHRAE Std 18 - Methods of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration.
- H. International Association of Plumbing and Mechanical Officials:
1. IAPMO IGC 187 – Roof Drains with Integral Overflow Drain.
  2. IAPMO Z124 - Plastic Plumbing Fixtures.
  3. IAPMO Z403-13 - Terrazzo, Concrete, and Natural Stone Plumbing Fixtures
- I. International Surface Fabricators Association
1. ISFA 2-01 – Classification and Standards for Solid Surfacing Material
- J. National Sanitation Foundation:
1. NSF 61 - Drinking Water System Components - Health Effects.

2. NSF 372 - Drinking Water System Components - Lead Content.

K. Plumbing Drainage institute:

1. PDI WH-201 – Water Hammer Arresters.

#### 1.5 SUBMITTALS

- A. Division 01 - General Requirements.
- B. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Samples: Submit two lavatory supply fittings fixtures for color matching.
- E. Manufacturer's Installation Instructions: Submit installation methods and procedures. Indicate assembly and support requirements
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
- H. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- I. Waterless Urinals: Submit recommended frequency of maintenance and parts replacement, methods of cleaning, sources of replacement supplies and parts.
- J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Division 01 - General Requirements.

#### 1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with State of MA standard.
- B. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.
- C. Provide plumbing fixture fittings in accordance with ASME A112.18.1 that prevent backflow from fixture into water distribution system.
- D. Maintain one copy of each document on site.

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

#### 1.9 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

#### 1.10 MOCKUP

- A. Division 01 - General Requirements.
- B. Construct mockup of typical bathroom group.
- C. Locate where directed by Architect/Engineer.
- D. Incorporate accepted mockup as part of Work.

#### 1.11 PRE-INSTALLATION MEETINGS

- A. Division 01 - General Requirements.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - General Requirements.
- B. Accept products on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures and specialties from damage by securing areas and by leaving factory packaging in place to protect fixtures and specialties, and prevent use.

#### 1.13 WARRANTY

- A. Division 01 - General Requirements.
- B. Furnish five year manufacturer warranty for plumbing fixtures.

#### 1.14 EXTRA MATERIALS

- A. Division 01 - General Requirements.
- B. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.
- C. Provide two loose keys for hose bibs and wall hydrants.
- D. Furnish supply of chemicals for treatment and testing during warranty period of solar hot water system.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. See schedule on drawings for additional requirements and accessories.
- B. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

### 2.2 LAVATORIES

- A. Manufacturers:
  - 1. American Standard
  - 2. Willoughby
  - 3. Bradley
  - 4. Kohler Co.
  - 5. Crane
  - 6. Acorn
  - 7. Substitutions: Division 01 - General Requirements.
- B. Basin: ASME A112.19.2; Vitreous China Wall Hung Basin: with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.
- C. Supply Faucets
  - 1. Manufacturers
    - a. Symmons
    - b. American Standard, Inc.
    - c. Kohler Company
    - d. Zurn Industries, Inc.
    - e. T&S Brass
    - f. Chicago Faucets
    - g. Substitutions: Division 01 - General Requirements.
  - 2. Supply Fitting: ASME A112.18.1; chrome plated supply fitting with open grid strainer, water economy aerator with maximum

- 3. Manual Operated Metering Faucet: ASME A112.18.1; chrome plated with metering options.
- D. For public hand washing facilities, provide tempered water through regulating device conforming to ASSE 1070.
- E. Waste Fittings: ASME A112.18.2 or ASTM F 409.
- F. Accessories:
  - 1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
  - 2. Perforated open strainer.
  - 3. Screwdriver stops.
  - 4. Rigid supplies.
  - 5. Trap and waste insulated and offset to meet ADA compliance.
- G. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs. See drawings for additional requirements and accessories.
- H. Lavatory faucet controls shall be located within 13 inches from leading edge of lavatories in accordance with federal register rules and regulations.

Comment [DS1]: not listed in references  
Comment [MW2R1]: Done

2.3 SINKS

- A. Manufacturers:
  - 1. American Standard.
  - 2. Elkay.
  - 3. Just.
  - 4. Kohler Co.
  - 5. Crane.
  - 6. Substitutions: Division 01 - General Requirements.
- B. Double Compartment Bowl: ASME A112.19.3; 18 gage thick, Type 302 stainless steel. Self-rimming and undercoated, with stainless steel drains 3-1/2 inch crumb cups and tailpieces, ledge back drilled for trim. See drawings for additional requirements and accessories.
- C. Supply Faucets
  - 1. Manufacturers

- a. American Standard.
  - b. Kohler Co.
  - c. Zurn.
  - d. Symmons.
  - e. T&S Brass.
  - f. Chicago Faucets.
  - g. Substitutions: Division 01 - General Requirements.
2. Supply Fitting: ASME A112.18.1; chrome plated supply fitting with open grid strainer, water economy aerator with maximum
- D. For public hand washing facilities, provide tempered water through regulating device conforming to ASSE 1070.
- E. Accessories: Chrome plated 17-gauge brass P-trap with clean-out plug and arm with escutcheon, screwdriver stop, and rigid supplies. Trap and waste insulated and offset to meet ADA compliance.
- F. Sink faucet controls shall be located within 13 inches from leading edge of sink in accordance with federal register rules and regulations.

#### 2.4 URINALS – WALL HUNG

- A. Manufacturers:
1. American Standard Plumbing
  2. Kohler Co.
  3. Zurn
  4. Toto
  5. Crane
  6. Substitutions: Division 01 - General Requirements.
- B. Urinal: vitreous china, wall hung siphon jet urinal with shields, integral trap, removable stainless steel strainer, 3/4 inch top spud, steel supporting hanger.
- C. Exposed Flush Valve: ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle escutcheon, integral screwdriver stop, vacuum breaker; maximum 0.125 gallon flush volume.

- D. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. See drawings for additional requirements and accessories.
- E. Provide elastomeric gasket complying with ASME A112.4.3, or approved setting compound, for fixture to flange connection.

2.5 WATER CLOSETS – TANK TYPE

- A. Closet Manufacturers:
  - 1. American Standard.
  - 2. Gerber Plumbing Fixtures LLC
  - 3. Toto.
  - 4. Kohler Company.
  - 5. Zurn Industries, Inc.
  - 6. Substitutions: Division 01 - General Requirements.
- A. Bowl: ASME A112.19.2; wall hung, vitreous china, reverse trap, whirlpool action close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, chrome plated bolt caps.
- B. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous china, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandal proof cover locking device.
- C. Bowl: ASME A112.19.2; floor mounted, vitreous china reverse trap, close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps.
- D. Water Consumption: Maximum 1.6 gallons [1.28 gallons] per flush.
- E. Seat
  - 1. Manufacturers:
    - a. American Standard, Inc.
    - b. Bemis Manufacturing Company
    - c. Church Seat Company
    - d. Olsonite
    - e. Substitutions: Division 01 - General Requirements.
  - 2. Seat: Solid white plastic, open front, brass bolts, with cover.

3. Seat: Solid white plastic, open front, extended back, less cover, complete with self-sustaining hinge.

## 2.6 REDUCED PRESSURE BACKFLOW PREVENTERS

- A. Manufacturers:
  1. Watts.
  2. Zurn.
  3. Apollo Valves.
  4. Substitutions: See Division 01 - General Requirements.
- B. Reduced Pressure Backflow Preventers:
  1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
- C. For cold water service and hot water 3" and smaller, provide all-bronze flanged backflow preventers with isolation valves, strainer, and air gap drain funnel.
- D. All backflow preventers shall be installed so they can be easily accessed for testing and maintenance. Install 36" above floor; pipe vent discharge to floor drain.

## 2.7 DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers:
  1. Watts.
  2. Zurn.
  3. Apollo Valves
- B. Substitutions: See Division 01 - General Requirements.
- C. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

## 2.8 CLEANOUTS

- A. Manufacturers:
  1. Josam.
  2. J.R. Smith.
  3. Zurn.
  4. Watts.

- 5. Wade.
- 6. Substitutions: Division 01 - General Requirements.
- B. ASME A112.36.2M; Cleanouts: Cast iron body with adjustable scoriated nickel bronze top and vandal proof screws.
- C. Interior Finished Wall Cleanouts: Line type with cast iron body, round epoxy coated gasketed cover and round stainless steel access cover secured with machine screw.
- D. Interior Unfinished Accessible Areas: Caulked or threaded type. Provide stack cleanouts on vertical rainwater leaders.
- E. Cleanout plugs shall be screwed brass installed either in cast iron-caulked ferrules or directly into threaded drainage fittings. Above floor cleanouts on stacks may be "Dandy" cleanouts.
- F. Refer to other Sections of the Specification for access doors which may be used in lieu of covers specified below.
- G. Cleanouts are to be accessible and locations coordinated with cabinetry, shelving and other architectural details. DO NOT place cleanouts where they will not be readily accessible.

2.9 EXPANSION TANKS

- A. Manufacturers:
  - 1. Amtrol.
  - 2. Bell and Gossett.
  - 3. Taco.
  - 4. Watts.
- B. Substitutions: Division 01 - General Requirements Construction: Welded steel, ASME labeled, tested and stamped in accordance with Section 8D of ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

Comment [MW3]: Cant find the ASME number.

2.10 FIXTURE SUPPORTS

- A. Manufacturers:
  - 1. J.R. Smith.
  - 2. Josam.
  - 3. Wade.
  - 4. Zurn.

5. MIFAB.
  6. Substitutions: Division 01 - General Requirements.
- B. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.
  - C. For each wall-hung lavatory, urinal, water cooler, drinking fountain and water closet, provide concealed carrier suited for fixture, location, wall thickness and material.
  - D. Concealed carriers with exposed arms for sinks and lavatories shall have acid-resisting enamel finish.

#### 2.11 FLOOR DRAINS

- A. Manufacturers:
  1. Josam.
  2. J.R. Smith
  3. Watts.
  4. Wade.
  5. Zurn
  6. Substitutions: Division 01 - General Requirements.
- B. ANSI A112.21.1, Round adjustable nickel-brass strainer, cast iron body, cast iron drainage flange, flashing clamp, and sediment bucket, provide with trap primer.
- C. ANSI A112.21.1. Square, cast iron, drainage flange with weep holes, and internal cast iron dome strainer: Provide trap primer.
- D. Drains shall have traps.

#### 2.12 FLOOR SINK

- A. Manufacturers:
  1. Josam.
  2. J.R. Smith.
  3. Watts.
  4. Zurn.
  5. Wade
  6. Substitutions: Division 01 - General Requirements.

- B. ANSI A112.21.1. Square, cast iron, drainage flange with weep holes, and internal cast iron dome strainer: Provide trap primer.
- C. Provide full, half, quarter grates, or less grate as required to suit job conditions.

2.13 HOSE BIBS

- A. Manufacturers:
  - 1. Woodford.
  - 2. Josam.
  - 3. Wade.
  - 4. Zurn.
  - 5. Watts.
  - 6. Substitutions: Division 01 - General Requirements.
- B. ANSI/ASSE 1011; Bronze or brass with integral mounting flange.

2.14 WALL HYDRANTS

- A. Manufacturers:
  - 1. Woodford.
  - 2. Josam.
  - 3. Wade.
  - 4. Zurn.
  - 5. Watts.
  - 6. Substitutions: Division 01 - General Requirements..
- B. Wall Hydrant: ANSI/ASSE 1019; self-draining type, lead free, freeze proof with removable key.

Comment [DS4]: Roof?  
Comment [MW5R4]: Done

2.15 INDIRECT WASTE FUNNEL

- A. F-1: Indirect waste funnel shall be:
  - 1. For pipe 3" and smaller: J.R. Smith #3821.
- B. Funnel shall have cast iron P-trap, cleanout, necessary adaptor for threaded outlet connection, trap primer and piping to prevent trap evaporation.

Comment [DS6]: Double check  
Comment [MW7R6]: Need ANSI/ ASTM

2.16 LAVATORY INSULATION KIT

- A. Manufacturers:
  - 1. McGuire
  - 2. Truebro
  - 3. Plumerex
  - 4. Substitutions: Division 01 - General Requirements.
- B. ANSI A177.1; Where Lavatories are noted to be insulated for ADA compliance, furnish safety covers consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

2.17 PLUMBING TRAPS

- A. Manufacturers:
  - 1. McGuire Manufacturing Co.
  - 2. Josam.
  - 3. Wade.
  - 4. Zurn.
  - 5. Substitutions: Division 01 - General Requirements.
- B. ASTM A888-20; Fixture traps shall be 17 gauge or heavier material; other traps shall be of same size and material as pipe on which trap occurs.
- C. Provide cleanout for each trap. Running traps shall have double hubs for two cleanouts.
- D. Provide deep traps with 4" minimum seal, for floor drains.

Comment [DS8]: MFG?

2.18 RECESSED VALVE BOXES

- A. Manufacturers:
  - 1. Woodford.
  - 2. Josam.
  - 3. Wade.
  - 4. Zurn.
  - 5. Watts.
  - 6. Substitutions: Division 01 - General Requirements.

- B. ASME A112.18.1;
- C. Refrigerator: Plastic preformed rough-in box with brass water control valve.
- D. Washing Machine: Plastic preformed rough-in box with brass water control valve, socket for 2 inch waste, and cover.

#### 2.19 TRAP PRIMERS

- A. Manufacturers:
  - 1. Woodford.
  - 2. Josam.
  - 3. Wade.
  - 4. Zurn.
  - 5. Watts.
  - 6. PPP.
  - 7. Substitutions: Division 01 - General Requirements.
- B. ASSE 1018; Corrosion resistant brass, temperature range -40 to 450 degrees, 1/2" male inlet and 1/2" female outlet, pressure operating range 35 to 75 psig.

#### 2.20 WATER HAMMER ARRESTORS

- A. Manufacturers:
  - 1. Woodford.
  - 2. Josam.
  - 3. Wade.
  - 4. Zurn.
  - 5. Watts.
  - 6. Substitutions: Division 01 - General Requirements.
- B. ANSI A112.26.1; sized in accordance with PDI, precharged, suitable for operation in temperature range -100 to 300 degrees F (-73 to 149 degrees C) and maximum 250

#### 2.21 STOPS

- A. Manufacturers:
  - 1. Brass Craft.

2. Watts.
  3. Nibco.
  4. McGuire.
  5. Substitutions: Division 01 - General Requirements.
- 
- B. ASME A112.18.1;
  - C. Chrome plated angle brass supply stop valve with full turn brass stem, lead free, inlet shall be 1/2-inch sweat, outlet shall be 3/8-inch compression.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Division 01 - General Requirements
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

#### 3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.
- B. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

#### 3.3 INSTALLATION

- A. Install Work in accordance with State of Massachusetts standards.
- B. Install in accordance with manufacturer's instructions.
- C. Install each fixture with trap, easily removable for servicing and cleaning.
- D. Provide chrome plated rigid supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- E. Install components level and plumb.
- F. Install and secure fixtures in place with wall carriers and bolts.
- G. Seal fixtures to wall and floor surfaces with sealant as specified in Division 07, color to match fixture.

- H. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- I. For ADA accessible water closets, install flush valve with handle to wide side of stall.
- J. Refer to architectural drawing for required mounting heights of fixtures.
- K. Install in accordance with manufacturer's instructions.
- L. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- M. Cleanouts shall be same size as the pipes served, up to 4 inches; 5 and 6 inch pipes shall have 4 inch cleanouts; 8 inch pipes shall have 6 inch cleanouts; 10 inch pipes and larger shall have 8 inch cleanouts.
- N. Install components level and plumb.
- O. Install water hammer arrestors with isolation valve in accessible locations.
- P. Trap primers shall be installed to serve all floor drains, provide distribution units as required for all drains.
- Q. Provide 1/2 grate cover on all floor sinks as required for discharge pipe into floor sink, cut inlet pipe on 45 degree angle.
- R. Trap primer connections shall be installed on cold water piping 1 1/2 inch diameter or less.

### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

### 3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

### 3.6 CLEANING

- A. Division 01 - General Requirements: Product Requirements: Final cleaning.
- B. Clean plumbing fixtures and equipment.

### 3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 - General Requirements: Product Requirements: Protecting installed construction.
- B. Do not permit use of fixtures before final acceptance.

3.8 COMMISSIONING OF EQUIPMENT

- A. Engage a factory-authorized service representative, who is familiar with this project, to participate and assist, if necessary, in the functional performance testing of this equipment with the Commissioning Agent.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; 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 or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section “Summary”, Paragraph 1.01A, entitled “Related Documents.”

1.3 GENERAL REQUIREMENTS

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.
- B. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.
- C. Each sub-bid filed with the Awarding Authority must be accompanied by BID BOND, or CASH or CERTIFIED CHECK or a TREASURER’S CHECK or CASHIERS’S CHECK issued by a responsible bank or trust company, payable to the Owner in the amount of five percent (5%) of the bid amount. A sub-bid accompanied by any other form of bid deposit will be rejected.
- D. Each sub-bid, submitted for the work of this Section, shall be on a form furnished by the Awarding Authority, as required by Section 44F of Chapter 149, as amended.
- E. Sub-Sub-Bid Requirements:
  - 1. CLASS OF WORK: REFERENCE ARTICLE:
    - a. Automatic Temperature Controls: Section 23 0900 – Instrumentation and Control for HVAC
    - b. Mechanical HVAC Insulation: Section 23 0700 - HVAC Insulation
    - c. Sheetmetal & Accessories: Section 23 3100 – HVAC Ducts and Casings
- F. The following drawings shall be part of this filed sub-bid section:

MECHANICAL DRAWINGS

M0.00	MECHANICAL ABBREVIATIONS, NOTES AND SYMBOLS
MD1.00	MECHANICAL DEMOLITION FLOOR PLANS
M1.00	MECHANICAL BASEMENT FLOOR PLAN
M1.01	MECHANICAL DUCTWORK FIRST FLOOR PLAN
M1.02	MECHANICAL DUCTWORK SECOND FLOOR PLAN
M5.00	MECHANICAL DETAILS
M6.00	MECHANICAL SCHEDULES

G. The following specifications sections shall be part of this file sub-bid section:

230001	Mechanical Filed Subbid
230400	General Conditions For Mechanical Trades
230517	Sleeves and Sleeve Seals for HVAC Piping
230529	Hangers and Supports for HVAC Piping and Equipment
230553	Identification for HVAC Piping and Equipment
230593	Testing, Adjusting, and Balancing for HVAC
230700	HVAC Insulation
230900	Instrumentation and Control for HVAC
230995	Variable Frequency Controllers
232113	Hydronic Piping
233100	HVAC Ducts and Casings
233300	Air Duct Accessories
233700	Air Outlets and Inlets
237300	Indoor Air Handling Units
238127	Variable Refrigerant Volume Systems
238200	Convection Heating Units

1.4 RELATED DOCUMENTS

- A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.5 FILING OF SUB-BIDS

- A. Include GENERAL CONDITIONS and applicable parts of Division 1 as part of this Section.
- 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.

1.6 SCOPE OF WORK

- A. The scope of work consists of the installation of all materials to be furnished under Division 23 and without limiting the generality thereof, consists of furnishing all labor, materials, equipment, plant, transportation, rigging, staging up to roof, appurtenances, and services necessary and/or incidental to properly complete all work as shown on the Mechanical drawings, as described in the Specifications, or as reasonably inferred from either, in the opinion of the Architect.

1.7 RELATED WORK SPECIFIED ELSEWHERE

- A. The following related work or materials shall be provided under the designated Sections and coordinated by the Contractor:

1. Cutting and Patching including openings in concrete masonry floors, walls and roof: The file sub bid contractor is responsible for cutting and patching as indicated in Specification 01 73 19 "Cutting and Patching", section 3.03B.1 & section C.1.
2. Staging and Scaffolding: Where staging and scaffolding is required, the Filed Subcontractor shall provide the entire installation for the scope of work. Refer to Section 01 50 00 "Temporary Facilities and Controls".
  - a. Staging shall be of approved design, erected and removed by experienced stage builders and shall have all accident prevention devices required by State and local laws.
3. Access doors and frames shall be furnished by the Filed Subcontractor for installation by the General Contractor in accordance with Section 08 31 13 "Access Doors and Frames".
4. Lifting and Hoisting: Where lifting and hoisting is required, the Filed Subcontractor shall provide the entire installation for the scope of work. Refer to Section 01 50 00 "Temporary Facilities and Controls"

#### 1.8 SUBMITTALS

- A. Attention is directed to Specification Section 01 3000 Submittals and Section 23 0400 General Conditions for Mechanical Trades

#### 1.9 RECORD DRAWINGS

- A. Refer to Specification Section 01 7839 Project Record Drawings and Section 23 0100 General Conditions for Mechanical Trades for the Record Drawing requirements for this section.
- B. The marked up As Built Drawings required to be maintained under this section are of the following Drawings:  
  
ALL DRAWINGS LISTED IN PARAGRAPH 1.1(F) OF THIS SECTION.
- C. Availability of marked up As Built drawings shall be a prerequisite to scheduling final inspection of this contract and said drawings and original contract documents will be used in checking completion of the work.
- D. Non-availability of marked up As Built drawings or inaccuracies therein may be grounds for cancellation and postponement of any scheduled final inspection by the Architect until the discrepancy has been corrected.

#### 1.10 OPERATING AND MAINTENANCE MANUALS

- A. Refer to Section 23 0400 General Conditions for Mechanical Trades for the Operating and Maintenance Manual requirements for this Contract.
- B. The Mechanical subcontractor shall provide the Contractor five (5) sets of operating and maintenance instructions of all mechanical and Mechanical equipment furnished and installed under this section.

- C. The Contractor shall collect the operating instructions, bind them into two complete sets and deliver them to the Architect who will check for completeness and deliver them to the Owner.
- D. Delivery of the operating and maintenance manuals shall be a condition precedent to final payment.

#### 1.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Refer to Section 23 0400 General Conditions for Mechanical Trades for the Instruction of Owner's Personnel requirements for this Contract..
- B. The Mechanical subcontractor shall instruct the Owner's personnel, at the site, in the use and maintenance of equipment installed under this section.
- C. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative shall be a condition precedent to final payment.

#### 1.12 GUARANTEE AND SERVICE

- A. Notwithstanding any other requirements of this contract, the Mechanical Subcontractor shall guarantee the performance of the installation and equipment included in this Section for one year from the date of Substantial Completion as defined in the General Conditions. Should any defects in materials or workmanship appear during this period, they shall be corrected or replaced by the Mechanical Subcontractor to the satisfaction of the Architect, and at no expense to the Owner.

#### 1.13 PERMITS

- A. The subcontractors attention is directed to the General Conditions. This subcontractor shall be responsible for obtaining and paying for all permits and inspections required to complete all Work described in this section.

### PART 2 MATERIALS

- A. Refer to specification sections referenced in 1.11 above for specific material requirements for work of this section.

### PART 3 EXECUTION

- A. Refer to specification sections referenced in 1.11 above for specific execution requirements for work of this section.

END OF SECTION

SECTION 23 04 00

GENERAL CONDITIONS FOR MECHANICAL TRADES

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to all Divisions 23 Sections.
- B. This section applies to certain sections of Division 26, "Electrical," and this section applies to all sections of Division 23, "Mechanical" of this project specification unless specified otherwise in the individual sections.
- C. The Drawings of other trades (Architectural, Food Service, Structural, Landscape, Civil, Mechanical, Fire Protection and Plumbing) shall be examined for coordination and familiarity of work with other Contractors. Any duplication or omission of provisions in this project should be brought to the attention of the Owners prior to Bidding.

1.3 DESCRIPTION

- A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.
- B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division. Where conflicts exist between the drawings and the specifications or between this section of the specifications and other sections, the more stringent or higher cost option shall apply.

1.4 INTENT

- A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation. Provide all parts necessary for the intended use, fully complete and operational, and installed in professional manner in accordance with the design intent.
- B. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and ready for operation as determined by good trade practice even if not

particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.

- C. Minor details not usually shown or specified but necessary for proper installation and operation shall be included in the work as though they were hereinafter shown or specified.
- D. Work under each Section shall include giving written notice to the Owner and Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section includes the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

## 1.5 DEFINITIONS

- A. No Exceptions Taken – reviewed and determined to be in general conformance with contract documents.
- B. “Approved equal” mean any product which in the opinion of the Engineer is equal in quality, arrangement, appearance, and performance to the product specified.
- C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.
- D. “Finished” refers to all rooms and areas to be specified to receive architectural treatment as indicated on the drawings. All rooms and areas not covered, including underground tunnels and areas above ceilings shall be considered not finished, unless otherwise noted.
- E. “Furnish” or “supply” shall mean purchase, deliver to, and off-load at the job site, ready to be installed including where appropriate all necessary interim storage and protection.
- F. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- G. “Install” shall mean set in place complete with all mounting facilities and connections as necessary ready for normal use or service.
- H. “Product” shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- I. “Provide” shall mean furnish (or supply) and install as necessary.
- J. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- K. Remove: The term “remove” means “to disconnect from its present position, remove from the premises and to dispose of in a legal manner.”

- L. Special Warranties: The term "Special Warranties" are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.
- M. Standard Product Warranties: The term "Standard Product Warranties" are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- N. "Subcontractor" means specifically the subcontractor working under this Division. Other Contractors are specifically designated "Plumbing Subcontractor", "General Contractor" and so on. Note: Take care to ascertain limits of responsibility for connecting equipment which requires connections by two or more trades.
- O. Substitutions: Requests for changes in products, materials, equipment, and methods of construction proposed by the Contractor are considered requests for "substitutions."
- P. "Wiring" shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.

#### 1.6 CONTRACT DOCUMENTS

- A. The two dimensional drawings govern the construction. They show the design intent and are part of the Contract Documents. BIM models are not part of contract documents. They are developed for convenience only.
- B. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect. (Do not scale the drawings)
- C. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Owner and Engineer shall be notified before proceeding with installations.
- D. The Owner may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.

#### 1.7 DISCREPANCIES IN DOCUMENTS

- A. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, shall be included in the Contract price. The Owner and Engineer shall decide on the item and the manner in which the work shall be installed.
- B. Where Drawings or Specifications conflict or are unclear, submit clarification request in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or un-clarities thus resolved.
- C. Where Drawings or Specifications do not coincide with manufacturers' recommendations or with applicable codes and standards, submit clarification request in form of an RFI

before installation. Otherwise, make changes in installed work required for compliance with manufacturer instructions or codes and standards within Contract Price.

- D. Where insufficient information exists in the documents to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements, where notification required by Paragraph (B) above has not been submitted, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in professional manner either concealed or exposed in accordance with the design intent.
- E. Where discrepancies exist between the mechanical, plumbing, fire protection, and electrical drawings in regards to what trade owns disconnects or starters, the discrepancy shall be brought to the Architect's attention in accordance with paragraph (B) above. If the scope is not resolved prior to the Award of Contract, Division 26 shall provide such items.

## 1.8 CODES AND STANDARDS

- A. Reference Standard Compliance
  - 1. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.
  - 2. Independent Testing Organization Certificate: In lieu of the label or listing indicated above, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.
- B. Wherever Codes and/or Standards are mentioned in these Specifications, the latest applicable edition or revision of the local building or life safety code shall be followed.
- C. The following Standards shall be used where referenced by the following abbreviations:

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ADC	Air Diffusion Council
AGA	American Gas Association
AIA	American Institute of Architects
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers

ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CGA	Compressed Gas Association
CSA	Canadian Standards Association
CISPI	Cast Iron Soil Pipe Institute
EJMA	Expansion Joint Manufacturing Association
EPA	Environmental Protection Agency
FM	Factory Mutual
FSSC	Federal Specification
HIS	Hydraulic Institute Standards
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
ISO	Insurance Services Office
MCAA	Mechanical Contractors Association of America
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NOFI	National Oil Fuel Institute
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PDI	Plumbing and Drainage Institute
SBI	Steel Boiler Industry (Division of Hydronics Institute)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
STI	Steel Tank Institute
UL	Underwriters' Laboratories

- D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.
- E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

#### 1.9 PERMITS AND FEES

- A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the work, file all necessary Drawings, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspection for his work, and deliver a copy to the Owner and Engineer before request for acceptance and final payment for the work.

#### 1.10 EQUIPMENT EQUIVALENTS AND SUBSTITUTIONS

- A. Certain manufacturers of material, apparatus or appliances are indicated in the drawings and specifications for this project. These items have been used as the basis of design, and as a convenience in fixing the minimum standard of quality, finish and design that is required. If the Contractor uses an "approved equal" alternative to the basis of design, and if the features of that alternative have an impact on other components of the Project, the Contractor shall include the necessary adjustments in those components, whether for architectural, structural, mechanical, electrical, fire protection, or any other elements, plus any adjustments for difference in performance.
- B. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for Architect and Engineer review.
- C. Where the Contractor proposes to use an item that is different from the basis of design in the Drawings and specifications, and that will require the redesign of the structure, partitions, foundations, piping, wiring or any other component of the mechanical, electrical, or architectural layout, the Contractor shall provide the necessary redesign of those components.
- D. Where the Contractor proposes to deviate (provide an equivalent or request for substitution) from the basis of design scheduled equipment or materials as hereinafter specified or shown on the drawings, they are required to submit a requested for substitution in writing. The Contractor shall state in their request whether it is a substitution, equivalent or a non approved equivalent to that specified and the amount of credit or extra cost involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.
- E. If an alternative or substitute item results in a difference in quantity and arrangement of structure, piping, ductwork, valves, pumps, insulation, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such additional equipment required by the system, at no additional cost to the Owner

including any costs added to other trades due to the equivalent change from the basis of design detailed in the drawings or included within the specifications.

- F. Equipment, material or devices submitted for review as a “substitution” shall meet the following requirements:
  
- G. Substitution Request Submittal: Requests for substitution will be considered if received in writing 14 days before the bid date. Requests received later than 14 days before the bid date may be considered or rejected at the discretion of the Engineer/Owner. Once the Contractor submits a complete request for substitution as determined by the engineer, the engineer reserves the right to request the time necessary to evaluate the request for substitution and review it with the Owner.
  
- H. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
  - a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
  - b. Samples, where applicable or requested.
  - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
  - d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
  - e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
  - f. Cost information, including a proposal of the net change, if any in the Contract Sum.
  - g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
  - h. Engineer's Action: Within one week of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance of a product substitution will be in the form of an Addendum.
  - i. Other Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.
    - 1) The request is directly related to an "or equal" clause or similar language in the Contract Documents.
    - 2) The specified product or method of construction cannot be provided within the Contract Time. The request will not be

considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

- 3) A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

#### 1.11 SUBMITTAL PROCEDURES

- A. Provide Submittals in accordance with the requirements of Division 1 and as indicated in the following.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
  2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
  1. Allow ten business days for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
  2. If an intermediate submittal is necessary, process the same as the initial submittal.
  3. Allow ten business days for reprocessing each submittal.
  4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.
- D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block. Submittals shall be arranged in order of specification sections.
  1. Include the following information on the label for processing and recording action taken.
    - a. Project name.
    - b. Date.
    - c. Name and address of Engineer.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Number, title and paragraph of appropriate Specification Section.
    - i. Drawing number and detail references, as appropriate.

- E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.
- F. Except for submittals for record, information or similar purposes, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.
- G. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, to indicate the action taken.

#### 1.12 SHOP DRAWINGS

- A. Submit neatly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
- B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review all shop drawings to be incorporated in the Mechanical Contract.
- C. Provide shop drawings for all devices specified under equipment specifications for all systems. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, dimensions, identification of products and materials included, compliance with specified standards, notation of coordination requirements, notation of dimensions established by field measurement and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures), of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.
- D. When a submittal could involve more than one trade, e.g., valves, piping, etc., the submitted shall be separated by traded involved, ie. HVAC, plumbing, fire protection, etc.
- E. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.
- F. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.
- G. "No Exception Taken" rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval does not in any way

relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings. Review of shop drawings shall not apply to quantity of material.

- H. After shop drawings have been reviewed, with no exceptions taken, no further changes will be allowed without the written consent of the Engineer.
- I. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.
- J. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer in writing at least five (5) working days prior to Bidding to allow for issuance of an Addendum.
- K. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.
- L. All submittals shall be made in electronic PDF format with searchable OCR (Optical Character Recognition) format. This excludes scanned and faxed materials.

#### 1.13 COORDINATION DRAWINGS AND BIM MODEL

- A. Coordination drawings are required for all mechanical and electrical trades. The content and procedures described in Division 01 shall be followed, with the additional requirements specifically for the mechanical and electrical trades as described in this Section. If a BIM model is not used on this project, the below requirements shall be accomplished in CAD.
- B. Prepare coordination drawings accordance with Division 1, at 1 to 1 (full) scale prepared at  $\frac{1}{4}'' = 1' - 0''$  detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
  - 1. The Contractor shall indicate the proposed locations of piping, conduit, ductwork, equipment, and materials. Include the following:
    - a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    - b. Equipment connections and support details.
    - c. Exterior wall and foundation penetrations.
    - d. Fire-rated wall and floor penetrations.
    - e. Sizes and locations of required concrete pads and bases.
- C. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
- D. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
- E. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

- F. The Contractor and each subcontractor shall sign and date each coordination drawing prior to submission.
- G. Work shall not be performed until coordination drawings have been approved by the architect and engineer.
- H. Electronic copies of the MEP floor plans and/or BIM model are available to use as a basis for preparing coordination drawings and can be provided by the Engineer. If the Contractor elects to obtain the Engineers electronic files an Electronic Drawing File Release Form must be submitted. This form must be signed by the Contractor, Owner, and Architect. Upon receipt of a signed copy of the Electronic Drawing File Release Form, the Engineer will provide copies of the electronic files for the Contractor's use. A copy of the Electronic Drawing File Release Form is appended to the end of this specification section
- I. Review by Engineer of coordination drawings is limited to confirming that requirements for coordination and preparation of plans have been complied with by the Contractor and shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with Architectural, Structural, Mechanical, Electrical and other related work.

#### 1.14 COORDINATION WITH OTHER DIVISIONS

- A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.
- B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, HVAC piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.
- C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.
- D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.
- E. The two dimensional drawings are diagrammatic. They indicate general arrangements of mechanical systems and other work, and are intended to convey sufficient information for skilled contractors and tradespeople to furnish and install complete systems. 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, provide all other components and materials to make the systems fully complete, coordinated with other systems and the structure and

space available, and operational. Similarly, the drawings 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 in order to avoid interferences and to meet ceiling heights and other Architectural requirements. Establish and provide offsets, changes in direction, and exact routings to coordinate all systems. Where conflicts or potential conflicts exist and engineering guidance is desired, submit a "Request for Information" (RFI).

- F. Controls contractor shall coordinate and sequences of operation with all other trades as necessary to provide a complete and functioning system.

#### 1.15 QUALITY CONTROL

- A. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.
- C. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled tradespeople, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.
- D. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.
- E. All labor for installation of mechanical systems shall be performed by experienced, skilled tradespeople under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, professional manner. The Engineer reserves the right to reject any work which, in their opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

#### 1.16 SHUTDOWNS

- A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner.
- B. The Engineer and the Owner shall be notified in writing of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.
- C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

#### 1.17 TEMPORARY UTILITIES

- A. General: Provide new materials and equipment; if acceptable to the Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
- C. First Aid Supplies: Comply with governing regulations.
- D. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.
- E. Utilities: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
  - 1. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Engineer, and will not be accepted as a basis of claims for a Change Order.
- F. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.
- G. Temporary Heat-Cool-Dehumidification: Provide temporary services required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate temporary services to produce the ambient condition required and minimize consumption of energy. The building's permanent HVAC systems shall not be used for these purposes.
- H. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.
- I. Termination and Removal: Unless the Engineer requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

1.18 Equipment Access

- A. Appliances, controls devices, heat exchangers and HVAC system components that utilize energy shall be accessible for inspection, service, repair and replacement without disabling the function of a fire-resistance-rated assembly or removing permanent construction, other appliances, venting systems or any other piping or ducts not connected to the *appliance* being inspected, serviced, repaired or replaced. A level working space not less than 30 inches deep and 30 inches wide (762 mm by 762 mm) shall be provided in front of the control side to service an *appliance*.

1.19 BUILDING FLUSH-OUT

- A. Building flush-out shall begin after construction ends and finishes are installed but prior to building occupancy. Prior to building flush-out, HVAC systems shall be balanced per Specification Section 23 05 93. Flush-out shall not occur until contractor receives permission to proceed from the Owner or Owner's representative..
- B. Building flush-out procedures shall include continuously operating all the building's new ventilation systems at maximum design outside air flow rates. For constant volume HVAC systems, ventilation systems shall operate at maximum design supply air flow rates.
- G. LEED REQUIREMENTS
  - 1. Path 1. Before occupancy
    - a. Install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot of gross floor area while maintaining an internal temperature of at least 60°F and no higher than 80°F and relative humidity no higher than 60%. Controls contractor to modify sequence of operations to allow for these conditions as needed.
  - 2. Path 2. During occupancy
    - a. If occupancy is desired before the flush-out is completed, the space may be occupied only after delivery of a minimum of 3,500 cubic feet of outdoor air per square foot (1 066 260 liters of outdoor air per square meter) of gross floor area while maintaining an internal temperature of at least 60°F (15°C) and no higher than 80°F (27°C) and relative humidity no higher than 60%. Once the space is occupied, it must be ventilated at a minimum rate of 0.30 cubic foot per minute (cfm) per square foot of outdoor air (1.5 liters per second per square meter of outdoor air) or the design minimum outdoor air rate determined in EQ Prerequisite Minimum Indoor Air Quality Performance, whichever is greater. During each day of the flush-out period, ventilation must begin at least three hours before occupancy and continue during occupancy. These conditions must be maintained until a total of 14,000 cubic feet per square foot of outdoor air (4 267 140 liters of outdoor air per square meter) has been delivered to the space.
- H. Contractor shall include hourly trend log and record during duration of building flush out.
- I. Log to include hours, airflow, temperature, and RH% of space and be summarized to confirm performance.
- J. Install new filtration media at end of flush-out and reset controls sequence of operation as needed.

K. CT HIGH PERFORMANCE BUILDING REQUIREMENTS

1. After construction ends and with all interior finishes installed but prior to building occupancy, flush the building continuously for at least ten days with outside air while maintaining an internal temperature between 60°F and 78°F and relative humidity no higher than 60%. Do not —bake outll the building by increasing the temperature of the space. Alternatively, use the following strategy: Flush out each space separately until 3,500 cubic feet of outside air per square foot of floor space has been delivered to that space. The space shall then be ventilated at the rate of 0.3 cubic feet per minute per square foot of floor space or the design minimum outside air rate, whichever is greater. This shall be performed for a minimum of three hours prior to occupancy and then during occupancy until a total of 14,000 cubic feet of outside air per square foot of floor area has been delivered to that space.
  - a. Compliance Assistance for Optional Strategy: Perform a building flush-out by supplying outside air continuously for ten days while maintaining an internal temperature of at least 60°F but no warmer than 78°F and relative humidity no higher than 60%.
  - b. Alternative Compliance Pathway for Optional Strategy: Flush out each space separately with outside air until 3,500 cubic feet of outside air has been delivered for each square foot of floor area. Then ventilate the area at the rate of 0.3 cubic feet of outside air per square foot of floor space or the design outside air rate, whichever is greater, at least three hours prior to occupancy. Maintain that ventilation rate until a total of 14,000 cubic feet of outside air per square foot of floor areas has been delivered to the space.

L. Contractor shall include hourly log and record during duration of building flush out.

M. Log to include hours, airflow, temperature, and RH% of space and be summarized to confirm performance.

N. Install new filtration media at end of flush-out and reset controls sequence of operation as needed.

1.20 PROJECT PHASING

A. Work under each Section shall include all necessary temporary connections, equipment, piping, heating, temperature control work, fire stopping, water heaters, labor, and material as necessary to accommodate the phasing of Construction as developed by the General Contractor or Construction Manager and approved by the Owner. All existing systems that pass-thru an area of the building shall remain operational during all phases of construction. No extra compensation shall be granted the Contractor for work required to maintain existing systems operational or to accommodate the construction phasing of the project.

1.21 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workpeople and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open

ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

- C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.
- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by tradespeople or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

#### 1.22 ADJUSTING AND TESTING

- A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.
- B. Where requested by the Engineer, a factory-trained service representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service representative shall supervise the initial operation of the equipment and instruct personnel responsible for operation and maintenance of the equipment. The service representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

#### 1.23 CLEANING

- A. The Contractor shall thoroughly clean and flush all piping, ducts and equipment of all foreign substances, oils, burrs, solder, flux, etc., inside and out before being placed in operation.
- B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.
- C. During the course of construction, all ducts and pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.
- D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.
- E. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
  - 1. Remove labels that are not permanent labels.
  - 2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-

- obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
  4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
- F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove and dispose of ALL waste materials, packaging material, skids etc. from the site and dispose of in a lawful manner in accordance with municipal, state and federal regulations.
- G. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

#### 1.24 OPERATING AND MAINTENANCE

- A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, the contractor shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least seven (7) days notice to the Owner and the Engineer in advance of this period.
- B. The Contractor shall include the maintenance schedule for the principal items of equipment furnished under this Division.
- C. The Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.
- D. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection: pumps; air conditioning equipment, controls, air handling equipment, compressors, boilers etc. These letters shall be bound into the operating and maintenance books.
- E. Refer to individual trade Sections for any other particular requirements related to operating instructions.
- F. Demonstration shall be recorded on USB Flash drive turned over to the Owner. Video recording shall be done in a professional manner with quality video (1080p resolution) and clear audible sound.

#### 1.25 OPERATING AND MAINTENANCE MANUALS

- A. Prepare operating and maintenance manuals in accordance with the requirements of Division 1 and as follows. The Contractor shall prepare up to six (6) copies of a complete maintenance and operating instructions manual, bound in booklet form. Organize operating and maintenance data into suitable sets of manageable size. Bind properly

indexed data in individual heavy-duty 3-ring vinyl-covered binders, with pocket folders for folded sheet information and designation partitions with identification tabs. Mark appropriate identification on front and spine of each binder.

- B. Manual shall 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 replacement parts.
  2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  4. Servicing and operating instructions including lubrication charts and schedules.
  5. Emergency and safety instructions.
  6. Spare parts list.
  7. Copies of warranties.
  8. Wiring diagrams.
  9. Recommended "turn around" cycles.
  10. Inspection procedures.
  11. Approved Shop Drawings and Product Data.
  12. Equipment Start-up Reports.
  13. Temperature control diagrams and written sequences of operations.
  14. Balance reports.
- C. Include in the manual, a tabulated equipment schedule for all equipment. Schedule shall include pertinent data such as: make, model number, serial number, voltage, normal operating current, belt size, filter quantities and sizes, bearing number, etc. Schedule shall include maintenance to be done and frequency.
- D. Maintenance and instruction manuals shall be submitted to the Owner at the same time as the seven (7) day notice is given prior to the instruction period.

#### 1.26 ACCEPTANCES

- A. The equipment, materials, quality, design and arrangement of all work installed under the Mechanical Sections shall be subject to the review of the Engineer.
- B. Within 30 days after the awarding of a Contract, the Mechanical Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Mechanical Sections. The intent to use the exact manufacturers and models specified does not relieve the Contractor of the responsibility of submitting such a list.
- C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Owner and Engineer, in writing, within 30 days of award of the Contract. In such instances, equipment substitutions may be made pending acceptance by the Engineer or the Owner's representative.
- D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Mechanical Contractor

shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

- E. If material or equipment is installed before it is reviewed and/or approved, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.
- F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

#### 1.27 RECORD DRAWINGS

- A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.
- B. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Items to be indicated include but are not limited to:
  - 1. Dimensional change
  - 2. Revision to drawing detail
  - 3. Location and depth of underground utility
  - 4. Revision to pipe routing
  - 5. Revision to electrical circuitry
  - 6. Actual equipment location
  - 7. Duct size and routing
  - 8. Location of concealed internal utility
  - 9. Changes made by Change Order
  - 10. Details not on original Contract Drawing
  - 11. Information on concealed elements which would be difficult to identify or measure later
- C. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
- D. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
- E. Note related Change Order numbers where applicable.
- F. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
- G. Final record documents shall be prepared in the latest electronic version and on USB Flash drive of all drawings and a clean set of reproducible paper copies shall be turned over to the Owner at the completion of the work.

#### 1.28 WARRANTIES AND BONDS

- A. The following general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties are to be included:
  - 1. General close-out requirements included in Division 1.
  - 2. Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of Divisions-2 through -50.
  - 3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

#### 1.29 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the

Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.

- H. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.
- I. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.
  - 1. Refer to individual Sections of Divisions-2 through -50 for specific content requirements, and particular requirements for submittal of special warranties.
- J. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- K. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
  - 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
  - 2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.
  - 3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

#### 1.30 GUARANTEES

- A. The Contractor shall guarantee all material and installation quality under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner. During this guarantee period, all defects developing through faulty equipment, materials or installation quality shall be corrected or replaced immediately by this Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.
- B. Contractor shall provide name, address, and phone number of all contractors and subcontractors and associated equipment they provided.

#### 1.31 PROJECT CLOSE-OUT

- A. Submit specific warranties, quality bonds, maintenance agreements, final certifications and similar documents in accordance with Division 1.
- B. Deliver tools, spare parts, extra stock, and similar items.

- C. Complete start-up testing of systems, including measuring and documenting all required startup checklist requirements documented in installation and maintenance instructions by the equipment manufacturer, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
- D. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
- E. Field Observation Procedures: On receipt of a request for an Engineers Field Observation, the Engineer will advise the Contractor of unfulfilled requirements. The Engineer will advise the Contractor of construction that must be completed or corrected before the certificate will be issued. Contractor shall submit written response to each corrective item including specific photos prior to final Engineering inspection.
  - 1. The Engineer will repeat the Field Observation when requested and assured that the Work has been substantially completed.
  - 2. Results of the completed list of unfulfilled items will form the basis of requirements for final acceptance.

END OF SECTION

Electronic Drawing File Release Form

DELIVERY OF FILES FOR: \_\_\_\_\_  
Project Name

In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by the Design Professional, the Client covenants and agrees that all such drawings and data are instruments of service of the Design Professional, who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

The Client further agrees not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Client agrees to waive all claims against the Design Professional resulting in any way from any unauthorized changes or reuse of the drawings and data for any other project by anyone other than the Design Professional.

In addition, the Client agrees, to the fullest extent permitted by law, to indemnify and hold the Design Professional harmless from any damage, liability or cost, including reasonable attorneys' fees and costs of defense, arising from any changes made by anyone other than the Design Professional or from any reuse of the drawings and data without the prior written consent of the Design Professional.

Under no circumstances shall transfer of the drawings and other instruments of service on electronic media for use by the Client be deemed a sale by the Design Professional, and the Design Professional makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.

\_\_\_\_\_  
Client's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company - Title

\_\_\_\_\_  
Architects' Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Firm - Title

\_\_\_\_\_  
Owner's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company - Title

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Pipe sleeves.
- B. Manufactured sleeve-seal systems.

1.3 RELATED REQUIREMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07 – Thermal and Moisture Protection.
- C. Division 09 - Finishes.
- D. Section 23 0523 - General-Duty Valves for HVAC Piping.
- E. Section 23 0553 - Identification for HVAC Piping and Equipment: Piping identification.
- F. Section 23 0716 - HVAC Equipment Insulation.
- G. Section 23 0719 - HVAC Piping Insulation.

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Valve Stem Packings: Two for each type and size of valve.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years experience.
  - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

## 1.8 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 PIPE SLEEVES

- A. Materials
  - 1. Galvanized-Steel Sheet: 0.0239-inch 0.6-mm minimum thickness; round tube closed with longitudinal joint.
  - 2. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

### 2.2 MANUFACTURED SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
  - 1. Flexicraft Industries; PipeSeal.
  - 2. Metraflex
  - 3. Link-Seal
  - 4. Substitutions: See Division - 01 General Requirements.
- B. Modular/Mechanical Seal:
  - 1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
  - 2. Provide watertight seal between pipe and wall/casing opening.
  - 3. Elastomer element size and material in accordance with manufacturer's recommendations.
  - 4. Glass reinforced plastic pressure end plates.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Lay out penetration and sleeve openings in advance, to permit provision in work. Coordinate work with architectural and structural work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed. Remedial work includes core drilling (see requirements below) for penetrations if walls are poured, or otherwise constructed, without required sleeves. Provide core drilling (see requirements below) of existing construction. Do not penetrate structural members without Structural Engineer's/Architect's written approval.
- B. Sleeve installation shall meet NFPA-101 requirements, UL rated assemblies requirements, and materials requirements of these specifications. Submit a list of the UL listed details that the Contractor intends on using on this project in all rated assemblies.
- C. Sleeves that penetrate outside walls, basement slabs, footings and beams shall be waterproof. Sleeves that penetrate floors shall be fireproof and waterproof.
- D. Identify unused sleeves and slots for future installation. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of pipe, duct, conduit or cable. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes.
- E. Do not support piping risers or conduit on sleeves.
- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 for materials.
- G. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements. Verify final equipment locations for roughing-in.

### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

### 3.3 APPLICATIONS

- A. Provide sleeves when penetrating footings, floors, walls, partitions, and other building components as follows:
  - 1. Interior walls, partitions, and floors: galvanized-steel sheet, unless steel or brass sleeves are specified elsewhere.
  - 2. Below Grade Exterior Walls: Zinc coated or cast iron pipe with mechanical sleeve seals. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
  - 3. Above Grade Exterior Walls: steel pipe sleeve with mechanical sleeve seals.
  - 4. Mechanical, Laundry, and Animal Room Floors above Basement: Galvanized steel pipe or black iron pipe with asphalt coating. Connect sleeve with floor plate except in mechanical rooms.

5. Concrete and masonry walls, concrete floor and roof slabs: galvanized-steel sheet
6. Floors with membrane waterproofing: stack sleeve fittings

### 3.4 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Install sleeves that are large enough to provide 1/4 inch annular clear space between sleeve and pipe or pipe insulation. Sleeves for insulated pipe and duct in non-fire rated construction shall accommodate continuous insulation without compression. Sleeves and/or penetrations in fire rated construction shall be packed with fire rated material that shall maintain the fire rating of the wall. Seal ends of penetrations to provide continuous vapor barrier where insulation is interrupted.
- E. Where pipes passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.
- F. Inserts:
  1. Provide inserts for placement in concrete formwork.
  2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- G. Structural Considerations:
  1. Do not penetrate building structural members unless indicated.
- H. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  1. Underground Piping: Mechanically expandable chloroprene inserts with bitumen sealed metal components.
  2. Aboveground Piping:
    - a. Pack solid using mineral fiber conforming to ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
  3. All Rated Openings: Caulk tight with fire stopping material conforming to ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
  4. Caulk exterior wall sleeves watertight with Mechanically expandable chloroprene inserts with mastic-sealed components.
- I. Vertical Piping:
  1. Sleeve Length: 1 inch above finished floor.

2. Provide sealant for watertight joint.
  3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
  4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- J. Clearances:
1. Provide allowance for insulated piping.
  2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
  3. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
- K. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a water-tight seal.
  6. Install in accordance with manufacturer's recommendations.
- L. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.5 CORE DRILLING

- A. Core drilling shall be avoided in new construction. Set sleeves prior to installation of structure for passage of pipes, conduit and ducts. Where core drilling is unavoidable (e.g. when individual sleeves are not installed or incorrectly located) or required by renovation projects, locate required openings prior to coring and submit locations for review.
- B. Coordinate openings with other Divisions.
- C. Do not disturb existing systems. Protect areas from damage.
- D. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.

### 3.6 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Pipe hangers and supports.
- B. Duct hangers and supports
- C. Hanger rods.
- D. Inserts.
- E. Flashing.
- F. Formed steel channel.
- G. Equipment bases and supports.

1.3 RELATED REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.4 REFERENCES

- A. American Society of Mechanical Engineers:
  - 1. ASME B31.1 - Power Piping.
  - 2. ASME B31.5 - Refrigeration Piping.
  - 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
  - 1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
  - 2. ASTM E814 - Standard Test Method for Fire Tests of Through Penetration Fire Stops.
  - 3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

- 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
  - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
  - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
  - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Intertek Testing Services (Warnock Hersey Listed):
  - 1. WH - Certification Listings.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Contractor shall design supports for multiple pipes and/or ducts, including pipe and duct stands, capable of supporting combined weight of supported systems, system contents, and fluid.
- B. Contractor shall design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.6 SUBMITTALS

- A. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- B. Product Data:
  - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Welding certificates.
- E. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.

#### 1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." and AWS D1.3, "Structural Welding Code--Sheet Steel."
- B. 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."

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years documented experience.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

#### 1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.11 WARRANTY

- A. Furnish five year manufacturer warranty for pipe hangers and supports.

### PART 2 PRODUCTS

#### 2.1 PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. 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. B-Line Systems, Inc.
  2. National Pipe Hanger Corporation
  3. Empire Industries, Inc.
  4. Globe Pipe Hanger Products Inc.
  5. Michigan Hanger Co.
  6. PHD Manufacturing, Inc.
  - 7.
- C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

## 2.2 DUCT HANGERS AND SUPPORTS

- A. Shall be in accordance with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible" except non-engineered wire hangers are not permitted. Engineered cable support systems may be used if they meet SMACNA, Ductmate or approved equal.
- B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- C. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- D. Strap and Rod Sizes: Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct.
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate

## 2.3 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

## 2.4 THERMAL SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield. Insert shall be capable of supporting weight of pipe, insulations and fluid without crushing.
- B. Manufacturers:
  - 1. Carpenter & Paterson, Inc.
  - 2. ERICO/Michigan Hanger Co.
  - 3. PHS Industries, Inc.
  - 4. Pipe Shields, Inc.

5. Rilco Manufacturing Company, Inc.
  6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
  - D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
  - E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
  - F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
  - G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Manufacturers:
  1. B-Line Systems, Inc.; a division of Cooper Industries.
  2. Empire Industries, Inc.
  3. Hilti, Inc.
  4. ITW Ramset/Red Head.
  5. MKT Fastening, LLC.
  6. Powers Fasteners.

## 2.6 MISCELLANEOUS MATERIALS

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- C. Equipment Supports: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

## 2.7 FORMED STEEL CHANNEL

- A. Manufacturers:
  - 1. Allied Tube & Conduit Corp.
  - 2. B-Line Systems
  - 3. Midland Ross Corporation, Electrical Products Division
  - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

## PART 3 EXECUTION

### 3.1 PIPE HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in other Division 23 Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system specific sections, install the following types:
  - 1. MSS Type 1 - Adjustable, Steel Clevis Hangers: For suspension of non-insulated or insulated stationary pipes, 2 inch to 30 inch size.
  - 2. MSS Type 2 - Yoke-Type Pipe Clamps: For suspension of 120 to 450 deg F pipes, 4 inch to 16 inch size, requiring up to 4 inches of insulation.
  - 3. MSS Type 3 - Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps: For suspension of pipes, 3/4 inch to 24 inch size, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. MSS Type 4 - Steel Pipe Clamps: For suspension of cold and hot pipes, 1/2 inch to 24 inch size, if little or no insulation is required.
  - 5. MSS Type 5 - Pipe Hangers: For suspension of pipes, 1/2 inch to 4 inch size, to allow off-center closure for hanger installation before pipe erection.
  - 6. MSS Type 12 - Extension Hinged or 2-Bolt Split Pipe Clamps: For suspension of non-insulated stationary pipes, 3/8 inch to 3 inch size.
  - 7. MSS Type 24 - U-Bolts: For support of heavy pipes, 1/2 inch to 30 inch.
  - 8. MSS Type 26 - Clips: For support of insulated pipes not subject to expansion or contraction.
  - 9. MSS Type 36 - Pipe Saddle Supports: For support of pipes, 4 inch to 36 inch size, with steel pipe base stanchion support and cast-iron floor flange.

10. MSS Type 37 - Pipe Stanchion Saddles: For support of pipes, 4 inch to 36 inch size, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  11. MSS Type 38 - Adjustable, Pipe Saddle Supports: For stanchion-type support for pipes, 2-1/2 inch to 36 inch size, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  12. MSS Type 41 - Single Pipe Rolls: For suspension of pipes, 1 inch to 30 inch size, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  13. MSS Type 43 - Adjustable Roller Hangers: For suspension of pipes, 2-1/2 inch to 20 inch size, from single rod if horizontal movement caused by expansion and contraction might occur.
  14. MSS Type 44 - Complete Pipe Rolls: For support of pipes, 2 inch to 42 inch size, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  15. MSS Type 45 - Pipe Roll and Plate Units: For support of pipes, 2 inch to 24 inch, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  16. MSS Type 46 - Adjustable Pipe Roll and Base Units: For support of pipes, 2 inch to 30 inch size, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. MSS Type 8 - Extension Pipe or Riser Clamps: For support of pipe risers, 3/4 inch to 20 inch size.
  2. MSS Type 42 - Carbon- or Alloy-Steel Riser Clamps: For support of pipe risers, 3/4 inch to 20 inch size, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. MSS Type 13 - Steel Turnbuckles: For adjustment up to 6 inches for heavy loads.
  2. MSS Type 14 - Steel Clevises: For 120 to 450 deg F piping installations.
  3. MSS Type 15 - Swivel Turnbuckles: For use with MSS Type 11, split pipe rings.
  4. MSS Type 16 - Malleable-Iron Sockets: For attaching hanger rods to various types of building attachments.
  5. MSS Type 17 - Steel Weldless Eye Nuts: For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. MSS Type 18 - Steel or Malleable Concrete Inserts: For upper attachment to suspend pipe hangers from concrete ceiling.
  2. MSS Type 19 - Top-Beam C-Clamps: For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. MSS Type 20 - Side-Beam or Channel Clamps: For attaching to bottom flange of beams, channels, or angles.
  4. MSS Type 21 - Center-Beam Clamps: For attaching to center of bottom flange of beams.

5. MSS Type 22 - Welded Beam Attachments: For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. MSS Type 23 - C-Clamps: For structural shapes.
  7. MSS Type 25 - Top-Beam Clamps: For top of beams if hanger rod is required tangent to flange edge.
  8. MSS Type 27 - Side-Beam Clamps: For bottom of steel I-beams.
  9. MSS Type 28 - Steel-Beam Clamps with Eye Nuts: For attaching to bottom of steel I-beams for heavy loads.
  10. MSS Type 29 - Linked-Steel Clamps with Eye Nuts: For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. MSS Type 30 - Malleable Beam Clamps with Extension Pieces: For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. MSS Type 34 - Side-Beam Brackets: For sides of steel or wooden beams.
  14. MSS Type 57 - Plate Lugs: For attaching to steel beams if flexibility at beam is required.
  15. MSS Type 58 - Horizontal Travelers: For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. MSS Type 39 - Steel Pipe-Covering Protection Saddles: To fill interior voids with insulation that matches adjoining insulation.
  2. MSS Type 40 - Protection Shields: Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. MSS Type 47 - Restraint-Control Devices: Where indicated to control piping movement.
  2. MSS Type 48 - Spring Cushions: For light loads if vertical movement does not exceed 1-1/4 inches.
  3. MSS Type 49 - Spring-Cushion Roll Hangers: For equipping Type 41 roll hanger with springs.
  4. MSS Type 50 - Spring Sway Braces: To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. MSS Type 51 - Variable-Spring Hangers: Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  6. MSS Type 52 - Variable-Spring Base Supports: Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  7. MSS Type 53 - Variable-Spring Trapeze Hangers: Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
  - a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

### 3.2 PIPE HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System for Multiple Hangers: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
  3. Floor Support: concrete pier or steel support.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
    - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
    - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
  - 5. Pipes NPS 8 and Larger: Include wood inserts.
  - 6. Insert Material: Length at least as long as protective shield.

- 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- N. Design hangers for pipe movement without disengagement of supported pipe.
- O. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00 Provide supplemental angles, channels and formed steel supports to support piping, ductwork, equipment, etc. from building's structure. Piping, ductwork, equipment, etc. shall not be supported from the roof deck.

### 3.3 DUCT HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5- 2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.

### 3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports to suspend equipment from structure overhead or to support equipment above floor. Fabricate supports from welded-structural steel shapes. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 21 05 48.

3.5 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.7 SCHEDULES

A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2 (Note 2)	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4

8	16	19	3/4	3/4
10	18	22	3/4	7/8
12	19	23	3/4	7/8
14	22	25	7/8	1
16	23	27	7/8	1
18	25	28	1	1
20	27	30	1	1-1/4
24	28	32	1-1/4	1-1/4

B. Plastic and Ductile Iron Pipe Hanger Spacing:

PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
ABS (All sizes)	4	3/8
FRP (All Sizes)	4	3/8
Ductile Iron (Note 2)		
PVC (All Sizes)	4	3/8

- C. Note 1: Refer to manufacturer's recommendations for grooved end piping systems.
- D. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Duct Markers.
- D. Pipe markers.
- E. Warning Signs and Labels
- F. Warning Tags
- G. Radon Labels
- H. Ceiling Tacks

1.3 RELATED REQUIREMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 09- Finishes.

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials.

1.5 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents:
  - 1. Valve Schedules: For each piping system. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 2. Equipment Schedules: For each item of equipment to be labeled. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## PART 2 PRODUCTS

### 1.6 EQUIPMENT NAMEPLATES

- A. Manufacturers:
  - 1. Advanced Graphic Engraving, LLC
  - 2. Brimar Industries, Inc; Kolbi Pipe Marker Co.
  - 3. Seton Identification Products
- B. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Plastic Labels for Equipment:
  - 1. Material and Thickness: Conform to ASTM D709. Multilayer, multicolor, plastic labels for mechanical engraving, minimum 1/16 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Black.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

D. Label Content: Include equipment's Drawing designation or unique equipment number.

#### 1.7 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving
2. Brady Corporation
3. Brimar Industries, Inc
4. Kolbi Pipe Marker Co
5. Seton Identification Products, a Tricor Company
6. Substitutions: See Division 01-General Requirements.

B. Metal Tags: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware. Brass wire-link, beaded chain or S-hook fasteners. Minimum 1-1/2 inch diameter with smooth edges.

#### 1.8 DUCT MARKERS

A. Manufacturers:

1. Brimar Industries, Inc
2. Kolbi Pipe Marker Co
3. Seton Identification Products

B. General Requirements for Manufactured Duct Labels: Preprinted self-adhesive, premium grade vinyl, color-coded, with lettering indicating service, and showing flow direction.

C. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch printed with UV and chemical resistant inks.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: Prepared with letter sizes according to ASME A13.1, at least 1-1/2 incheshigh.

#### 1.9 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation
2. Brimar Industries, Inc
3. Kolbi Pipe Marker Co
4. MIFAB, Inc
5. Seton Identification Products

- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: Prepared with letter sizes according to ASME A13.1, at least 1-1/2 incheshigh.

#### 1.10 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inchthick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inchfor name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

#### 1.11 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.

2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Red, white, black.

#### 1.12 RADON LABELS

- A. Radon pipe discharge shall be provided with labeling similar to the following:
  1. Caution, radon discharged fumes do not breathe fumes.
- B. Radon fan and associated equipment shall be provided with labeling similar to the following:
  1. Caution, this is a component of radon reduction system, don't alter or disconnect.
- C. Radon fan power and electrical devices shall be provided with labeling similar to the following:
  1. Caution, radon fan circuit do not turn off.
- D. Radon fan switch shall be provided with labeling similar to the following:
  1. Caution, radon fan switch, leave on.
- E. Radon reduction system labels shall be provided with labeling similar to the following:
  1. Labeling with information for:
    - a. Installed By:
    - b. Phone number:
    - c. Installation Date:
    - d. License / Certificate #:
    - e. Initial Vacuum pressure:
    - f. Note: It is advised that this building be tested for radon at least every two years as required or recommended by state and local agencies.

#### 1.13 CEILING TACKS

- A. Manufacturers:
  1. Brimar
  2. Craftmark
- B. Seton Identification Products Description: Steel with 3/4 inch diameter color coded head.
- C. Color code as follows:
  1. HVAC Equipment: Yellow.
  2. Fire Dampers and Smoke Dampers: Red.
  3. Heating/Cooling Valves: Blue.

### PART 2 EXECUTION

#### 2.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

## 2.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment, including all scheduled equipment on the drawings, air terminal units, automatic control devices, control panels, instruments, relays and major control components.
- B. Locate equipment labels where accessible and readable from the floor.
- C. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

## 2.3 VALVE TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application:
  - 1. Valve-Tag Size and Shape: 1-1/2 inches, round.
  - 2. Valve-Tag Color: Natural
  - 3. Letter Color: Black

## 2.4 PIPE LABEL INSTALLATION

- A. Install plastic pipe markers in accordance with manufacturer's instructions.
- B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- E. Pipe Label Color Schedule:

1. Potable, Cooling, Heating and Other Water Piping:
  - a. Background Color: Green.
  - b. Letter Color: White.
2. Combustible Fluid Piping:
  - a. Background Color: Brown.
  - b. Letter Color: White.
3. Flammable & Oxidizing Fluid Piping:
  - a. Background Color: Yellow.
  - b. Letter Color: Black.
4. Toxic & Corrosive Piping:
  - a. Background Color: Orange.
  - b. Letter Color: Black.

F. Identify valves in main and branch piping with tags.

## 2.5 DUCT LABEL INSTALLATION

A. Install duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

## 2.6 CEILING TACK INSTALLATION

A. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

## 2.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Sound measurement of equipment operating conditions.
- E. Vibration measurement of equipment operating conditions.

1.3 RELATED REQUIREMENTS

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

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. AABC (NSTSB) - AABC National Standards for Total System Balance
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems;.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing;.

1.5 SUBMITTALS

- A. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
  - 1. Submit to Architect.
  - 2. Submit to the Commissioning Authority.

3. Submit to Engineer of Record.
4. Submit six weeks prior to starting the testing, adjusting, and balancing work.
5. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
6. Include at least the following in the plan:
  - a. Preface: An explanation of the intended use of the control system.
  - b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
  - c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
  - d. Identification and types of measurement instruments to be used and their most recent calibration date.
  - e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
  - f. Final test report forms to be used.
  - g. Detailed step-by-step procedures for TAB work for each system and issue, including:
    - 1) Terminal flow calibration (for each terminal type).
    - 2) Diffuser proportioning.
    - 3) Branch/submain proportioning.
    - 4) Total flow calculations.
    - 5) Rechecking.
    - 6) Diversity issues.
  - h. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
  - i. Details of how TOTAL flow will be determined; for example:
    - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
    - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
  - j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
  - k. Confirmation of understanding of the outside air ventilation criteria under all conditions.
  - l. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
  - m. Method of checking building static and exhaust fan and/or relief damper capacity.
  - n. Methods for making coil or other system plant capacity measurements, if specified.
  - o. Time schedule for TAB work to be done in phases (by floor, etc.).
  - p. Description of TAB work for areas to be built out later, if any.
  - q. Time schedule for deferred or seasonal TAB work, if specified.
  - r. False loading of systems to complete TAB work, if specified.
  - s. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
  - t. Interstitial cavity differential pressure measurements and calculations, if specified.
  - u. differential pressure measurements and calculations between the building and its exterior.

- v. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
  - w. Procedures for formal progress reports, including scope and frequency.
  - x. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Submit under provisions of Division 01 – General Conditions.
  - 2. Submit to the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
  - 3. Revise TAB plan to reflect actual procedures and submit as part of final report.
  - 4. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and Engineer of Record and for inclusion in operating and maintenance manuals.
  - 5. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
  - 6. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  - 7. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  - 8. Units of Measure: Report data in both I-P (inch-pound) units.
  - 9. Include the following on the title page of each report:
    - a. Name of Testing, Adjusting, and Balancing Agency.
    - b. Address of Testing, Adjusting, and Balancing Agency.
    - c. Telephone number of Testing, Adjusting, and Balancing Agency.
    - d. Project name.
    - e. Project location.
    - f. Project Architect.
    - g. Project Engineer.
    - h. Project Contractor.
    - i. Project altitude.
    - j. Report date.
- E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
  - 1. AABC (NSTSB), AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
  3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
  4. SMACNA (TAB) Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
  2. Having minimum of three years documented experience.
  3. Certified by one of the following:
    - a. AABC, Associated Air Balance Council completion submit AABC National Performance Guaranty.
    - b. NEBB, National Environmental Balancing Bureau
    - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

### 3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Fans are rotating correctly.
  7. Fire and volume dampers are in place and open.
  8. Air coil fins are cleaned and combed.
  9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and connected.
  11. Duct system leakage is minimized.
  12. Hydronic systems are flushed, filled, and vented.
  13. Pumps and fans are rotating correctly.
  14. Proper strainer baskets are clean and in place.
  15. Service and balance valves are open.

### 3.3 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers and control providers whose work will be tested, adjusted, or balanced.

### 3.4 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### 3.5 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
  - 1. Running log of events and issues.
  - 2. Discrepancies, deficient or uncompleted work by others.
  - 3. Contract interpretation requests.
  - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. Check and adjust systems approximately two seasons after final acceptance and submit report.

### 3.6 AIR SYSTEM PROCEDURE

- A. Work with Control vendor to establish minimum setpoints necessary to satisfy contract documents. Iterative testing to determine these minimum setpoints will be expected to be in the submittals.
- B. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- C. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- D. Measure air quantities at air inlets and outlets.

- E. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- F. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- G. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

### 3.7 WATER SYSTEM PROCEDURE

- A. Work with Control vendor to establish minimum setpoints necessary to satisfy contract documents. Iterative testing to determine these minimum setpoints will be expected in the submittals.
- B. Adjust water systems to provide required or design quantities.
- C. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- D. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- E. Effect system balance with automatic control valves fully open to heat transfer elements.
- F. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- G. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.8 COMMISSIONING

- A. See Division 01 General Requirements for additional requirements.

3.9 SCOPE

- A. Test, adjust, and balance the following:
1. Plumbing Pumps.
  2. Steam Condensate Pumps.
  3. Boiler Feedwater Pumps.
  4. HVAC Pumps.
  5. Boilers
  6. Furnaces
  7. Chillers
  8. Cooling Towers
  9. Air Cooled Refrigerant Condensers.
  10. Packaged Roof Top Heating/Cooling Units.
  11. Packaged Terminal Air Conditioning Units.
  12. Variable Refrigerant Volume/Flow Systems (VRF or VRV)
  13. Computer Room Air Conditioning Units.
  14. Air Coils.
  15. Evaporative Humidifier.
  16. .
  17. Terminal Heat Transfer Units.
  18. Induction Units.
  19. Air Handling Units.
  20. Dedicated Outdoor Air Units.
  21. Fans.
  22. Air Filters.
  23. Air Terminal Units.
  24. Air Inlets and Outlets.
  25. Chilled Beams
  26. Heat Pump

### 3.10 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
  - 1. Manufacturer.
  - 2. Model/Frame.
  - 3. HP/BHP.
  - 4. Phase, voltage, amperage; nameplate, actual, no load.
  - 5. RPM.
  - 6. Service factor.
  - 7. Starter size, rating, heater elements.
  - 8. Sheave Make/Size/Bore.
  - 9. VFD Setpoints.
  - 10. ECM Setpoints.
  
- B. V-Belt Drives:
  - 1. Identification/location.
  - 2. Required driven RPM.
  - 3. Driven sheave, diameter and RPM.
  - 4. Belt, size and quantity.
  - 5. Motor sheave diameter and RPM.
  - 6. Center to center distance, maximum, minimum, and actual.
  
- C. Pumps:
  - 1. Identification/number.
  - 2. Manufacturer.
  - 3. Size/model.
  - 4. Impeller.
  - 5. Service.
  - 6. Design flow rate, pressure drop, BHP.
  - 7. Actual flow rate, pressure drop, BHP.
  - 8. Discharge pressure.
  - 9. Suction pressure.
  - 10. Total operating head pressure.
  - 11. Shut off, discharge and suction pressures.
  - 12. Shut off, total head pressure.
  
- D. Combustion Equipment:
  - 1. Boiler manufacturer.
  - 2. Model number.
  - 3. Serial number.
  - 4. Firing rate.
  - 5. Overfire draft.
  - 6. Gas meter timing dial size.
  - 7. Gas meter time per revolution.
  - 8. Gas pressure at meter outlet.
  - 9. Gas flow rate.
  - 10. Heat input.
  - 11. Burner manifold gas pressure.
  - 12. Percent carbon monoxide (CO).
  - 13. Percent carbon dioxide (CO<sub>2</sub>).
  - 14. Percent oxygen (O<sub>2</sub>).
  - 15. Percent excess air.
  - 16. Flue gas temperature at outlet.

17. Ambient temperature.
  18. Net stack temperature.
  19. Percent stack loss.
  20. Percent combustion efficiency.
  21. Heat output.
- E. Air Cooled Condensers:
1. Identification/number.
  2. Location.
  3. Manufacturer.
  4. Model number.
  5. Serial number.
  6. Entering DB air temperature, design and actual.
  7. Leaving DB air temperature, design and actual.
  8. Number of compressors.
- F. Chillers:
1. Identification/number.
  2. Manufacturer.
  3. Capacity.
  4. Model number.
  5. Serial number.
  6. Evaporator entering water temperature, design and actual.
  7. Evaporator leaving water temperature, design and actual.
  8. Evaporator pressure drop, design and actual.
  9. Evaporator water flow rate, design and actual.
  10. Condenser entering water temperature, design and actual.
  11. Condenser pressure drop, design and actual.
  12. Condenser water flow rate, design and actual.
- G. Cooling Tower:
1. Tower identification/number.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Rated capacity.
  6. Entering air WB temperature, specified and actual.
  7. Leaving air WB temperature, specified and actual.
  8. Ambient air DB temperature.
  9. Condenser water entering temperature.
  10. Condenser water leaving temperature.
  11. Condenser water flow rate.
  12. Fan RPM.
- H. Heat Exchangers:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Model number.
  6. Serial number.
  7. Steam pressure, design and actual.
  8. Primary water entering temperature, design and actual.
  9. Primary water leaving temperature, design and actual.

10. Primary water flow, design and actual.
  11. Primary water pressure drop, design and actual.
  12. Secondary water leaving temperature, design and actual.
  13. Secondary water flow, design and actual.
  14. Secondary water pressure drop, design and actual.
- I. Cooling Coils:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Air flow, design and actual.
  6. Entering air DB temperature, design and actual.
  7. Entering air WB temperature, design and actual.
  8. Leaving air DB temperature, design and actual.
  9. Leaving air WB temperature, design and actual.
  10. Water flow, design and actual.
  11. Water pressure drop, design and actual.
  12. Entering water temperature, design and actual.
  13. Leaving water temperature, design and actual.
  14. Saturated suction temperature, design and actual.
  15. Air pressure drop, design and actual.
- J. Heating Coils:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Air flow, design and actual.
  6. Water flow, design and actual.
  7. Water pressure drop, design and actual.
  8. Entering water temperature, design and actual.
  9. Leaving water temperature, design and actual.
  10. Entering air temperature, design and actual.
  11. Leaving air temperature, design and actual.
  12. Air pressure drop, design and actual.
- K. Electric Duct Heaters:
1. Manufacturer.
  2. Identification/number.
  3. Location.
  4. Model number.
  5. Design kW.
  6. Number of stages.
  7. Phase, voltage, amperage.
  8. Test voltage (each phase).
  9. Test amperage (each phase).
  10. Air flow, specified and actual.
  11. Temperature rise, specified and actual.
- L. Induction Units:
1. Manufacturer.
  2. Identification/number.
  3. Location.

4. Model number.
  5. Size.
  6. Design air flow.
  7. Design nozzle pressure drop.
  8. Final nozzle pressure drop.
  9. Final air flow.
- M. Air Moving Equipment:
1. Location.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Arrangement/Class/Discharge.
  6. Air flow, specified and actual.
  7. Return air flow, specified and actual.
  8. Outside air flow, specified and actual.
  9. Total static pressure (total external), specified and actual.
  10. Inlet pressure.
  11. Discharge pressure.
  12. Sheave Make/Size/Bore.
  13. Number of Belts/Make/Size.
  14. Fan RPM.
- N. Return Air/Outside Air:
1. Identification/location.
  2. Design air flow.
  3. Actual air flow.
  4. Design return air flow.
  5. Actual return air flow.
  6. Design outside air flow.
  7. Actual outside air flow.
  8. Return air temperature.
  9. Outside air temperature.
  10. Required mixed air temperature.
  11. Actual mixed air temperature.
  12. Design outside/return air ratio.
  13. Actual outside/return air ratio.
- O. Exhaust Fans:
1. Location.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Air flow, specified and actual.
  6. Total static pressure (total external), specified and actual.
  7. Inlet pressure.
  8. Discharge pressure.
  9. Sheave Make/Size/Bore.
  10. Number of Belts/Make/Size.
  11. Fan RPM.
- P. Duct Traverses:
1. System zone/branch.
  2. Duct size.

3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

Q. Duct Leak Tests:

1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
  - a. Blower.
  - b. Orifice, tube size.
  - c. Orifice size.
  - d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

R. Air Monitoring Stations:

1. Identification/location.
2. System.
3. Size.
4. Area.
5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.

S. Flow Measuring Stations:

1. Identification/number.
2. Location.
3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Station calibrated setting.

T. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.

7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

U. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section Includes:
1. HVAC piping insulation, jackets and accessories.
  2. HVAC equipment insulation, jackets and accessories.
  3. HVAC ductwork insulation, jackets, and accessories.
- B. Related Sections:
1. Division 01 – General Requirements
  2. Division 07 – Firestopping
  3. Division 09 – Finishes
  4. Section 23 0553 – Identification of HVAC Piping and Equipment
  5. Section 23 3100 – HVAC ducts and casings
  6. Section 23 2113 – Hydronic Piping

1.3 REFERENCES

- A. ASTM International:
1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  2. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
  3. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
  4. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
  5. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  6. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  7. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
  8. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  9. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  10. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
  11. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

12. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
13. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
14. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
15. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
16. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
17. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
18. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
19. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
20. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
21. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:

1. UL 1978 - Standard for Safety for Grease Ducts.

#### 1.4 SUBMITTALS

- A. See Division 01- General Requirements
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

- E. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- F. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

#### 1.6 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements:
- B. Convene minimum one week prior to commencing work of this section.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping. Store all insulation materials in a clean, dry environment.

#### 1.8 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

#### 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.10 WARRANTY

- A. Division 01 - Execution and Closeout Requirements.

#### 1.11 SCHEDULING

- A. Schedule insulation application after pressure and leak testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

### PART 2 PRODUCTS

#### 2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## 2.2 MANUFACTURER

- A. Manufacturers for Flexible Glass Fiber (FGF), Pre-Molded Glass Fiber (PGF) and Rigid Glass Fiber (RGF) Insulation Products:
  1. Knauf Insulation
  2. Johns Manville Corporation
  3. Owens-Corning.
  4. Substitutions: Division 01.
- B. Manufacturers for Closed Cell Elastomeric (CCE) Insulation Products:
  1. Aeroflex. USA, Inc.
  2. Armacell, LLC (Interior- ArmaFlex, Exterior- ArmaTuff)
  3. K-Flex USA LLC
  4. Substitutions: Division 01.
- C. Manufacturers for Polyisocyanurate Foam Insulation Products: (steam only)
  1. Dow Chemical Company.
  2. Owens-Corning
  3. Johns Manville Corporation
  4. Substitutions: Division 01.
- D. Manufacturers for Fire Rated (FR) Insulation Products:
  1. 3M Fire Barrier Duct Wrap 615+.
  2. Morgan Theramal Ceramics Pyroscat DuctWrap XL.
  3. Unifrax FyreWrap Elite 1.5.
  4. Substitutions: Division 01.
- E. Manufacturers for Jacketing (PVC):
  1. Johns Manville
  2. P.I.C. Plastics Inc.
  3. Proto Corporation
  4. Substitutions: Division 01.
- F. Manufacturers for Jacketing (ALM):
  1. Childers Brand
  2. ITW Insulation Systems
  3. RPR Products
  4. Substitutions: Division 01.
- G. Manufacturers for exterior pipe/ duct waterproof jacketing (WJ):
  1. Polyguard Products, Inc.; Alumaguard 60.
  2. Venture Tape Corporation; VentureClad Plus.
  3. MFM Building Products Corp: Flex Clad 400
  4. Substitutions: Division 01.

## 2.3 PIPE INSULATION

- A. Pre-Molded Glass Fiber (PGF) Insulation:
  1. ASTM C547 and ASTM C795, rigid molded, noncombustible.
  2. 'K' ('Ksi') Value: ASTM C177, 0.24 at 75°F.
  3. Maximum Service Temperature: 850°F.

4. Maximum Moisture Absorption: 0.2 percent by volume.
  5. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; self-sealing lap, moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (ASJ-SSL).
- B. Closed Cell Elastomeric (CCE) Insulation:
1. Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
  2. Minimum Service Temperature: Minus 40°F.
  3. Maximum Service Temperature: 220°F.
  4. Connection: Waterproof vapor barrier adhesive.

#### 2.4 PIPE INSULATION JACKETS

- A. Polyvinyl-chloride (PVC): Plastic Pipe Jacket.
1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
  2. Thickness: 10 mil.
  3. Connections: Brush on welding adhesive.
- B. Aluminum (ALM): Self-Adhesive Waterproofing Jacket. Minimum 12 mil thick, vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; UV resistant, zero permeability with textured aluminum-foil facing, impact and tear resistant.

#### 2.5 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: hydrous calcium silicate. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self-adhesive closure. Thickness to match pipe insulation.
- F. Valve insulation Wraps: White, noncombustible, conforming to ASTM E 84. Match insulation thickness to pipe size. Valve covers shall be easily removable.

#### 2.6 EQUIPMENT INSULATION

- A. Closed Cell Elastomeric (CCE) Insulation:
1. Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3, in sheet form.
  2. Minimum Service Temperature: -40°F.
  3. Maximum Service Temperature: 220°F.
  4. Connection: Waterproof vapor barrier adhesive.
- B. [EQUIPMENT INSULATION JACKETS] – For exterior mounted equipment only

- C. PVC Plastic Equipment Jacket:
  - 1. Product Description: ASTM D1785, sheet material, off-white color.
  - 2. Minimum Service Temperature: -40°F.
  - 3. Maximum Service Temperature: 150°F.
  - 4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
  - 5. Thickness: 10 mil.
  - 6. Connections: Pressure sensitive color matching vinyl tape.
  
- D. Aluminum Equipment Jacket:
  - 1. ASTM B209
  - 2. Thickness: 0.020 inch thick sheet.
  - 3. Finish: Smooth.
  - 4. Joining: Longitudinal slip joints and 2 inch laps.
  - 5. Fittings: 0.02 inch thick die shaped fitting covers with factory attached protective liner.
  - 6. Metal Jacket Bands: 3/8 inch wide; 0.02 inch thick aluminum.

## 2.7 EQUIPMENT INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- E. Pump body insulation: Provide insulation for pump body and components on chilled water systems. Provide pre-cut insulation from manufacturer or provide field fabricated insulation to ensure pump body and components are completely protected.
- F. Adhesives: Compatible with insulation. Refer to manufacturers' installation manual.

## 2.8 DUCTWORK INSULATION

- A. Flexible Glass Fiber (FGF) Insulation: ASTM C553 Type I, II, or III, ASTM C1290 Type III, in accordance to NFPA 90A and NFPA 90B for duct coverings, with ASTM C1136 foil scrim kraft (FSK).
  - 1. Thermal performance: 1.0 lb/ft<sup>3</sup>, 7.4 ft<sup>2</sup> hr °F/btu minimum R-value for 2" thick at 75°F mean temperature per ASTM C177 and ASTM C518.
  - 2. Operating temperature range: 40°F to 250°F.
  - 3. Water vapor permeance: 0.02 perms maximum per ASTM E96.
  - 4. Water vapor sorption: 5% by weight maximum per ASTM C1104.
  - 5. Corrosiveness: Does not accelerate per ASTM C665.
  - 6. Fungi growth: No fungi growth per ASTM C1338.
  
- B. Rigid Glass Fiber (RGF) Insulation: Glass fiber board, ASTM C 612 Type 1A or 1B, in accordance to NFPA 90A and NFPA 90B for duct coverings, with ASTM C 1136 foil scrim kraft (FSK).
  - 1. Thermal performance: 8.7 ft<sup>2</sup> hr °F/btu minimum R-value for 2" thick at 75°F mean temperature per ASTM C177 and ASTM C518.
  - 2. Operating temperature range: 0°F to 450°F.
  - 3. Water vapor permeance: 0.02 perms maximum per ASTM E96.

4. Water vapor sorption: 5% by weight maximum per ASTM C1104.
  5. Corrosiveness: Does not accelerate per ASTM C665.
  6. Fungi growth: No fungi growth per ASTM C1338.
- C. Closed Cell Elastomeric (CCE) Insulation:
1. Thermal performance: 8.0 ft<sup>2</sup> hr °F/btu minimum R-value for 2" thick at 75°F mean temperature per ASTM C177 and ASTM C518.
  2. Operating temperature range: -40°F to 220°F.
  3. Water absorption: 0.2% by volume per ASTM C 209 or ASTM C1763.
  4. Water vapor permeability: 0.08 perm-in per ASTM E 96.
  5. Ultraviolet (UV) resistance: Excellent per ASTM G 53 or ASTM G 90.
  6. Weatherability: Excellent per ASTM D 471.
- D. Fire Rated (FR) Insulation:
1. Inorganic blanket encapsulated with scrim reinforced foil meeting UL 1978
  2. Thermal Conductivity: 0.42 at 500°F.
  3. Weight: 1.4 pound per square foot.
  4. Surface Burning Characteristics: Maximum 0/0 flame spread/smoke developed index when tested in accordance with ASTM E84.
- E. Technical Data:
1. Insulation shall pass when tested in accordance with the following:
    - a. Non-combustibility per ASTM E136.
    - b. Fire resistance (wall) per ASTM E119.
    - c. Durability test per ASTM C518.
    - d. Internal fire test per ASTM E2336.
    - e. Fire engulfment (duct) per ASTM E814.
    - f. ULC grease duct test protocol.
    - g. Grease duct clearances per UL1978.
    - h. Air duct ventilation enclosure per ISO6944.
  2. Thermal performance: 6.3 ft<sup>2</sup> hr °F/btu minimum R-value for 1-1/2" thick at 75°F mean temperature per ASTM C177 and ASTM C518.

## 2.9 DUCTWORK JACKETS

- A. Aluminum (ALM): Self-Adhesive Waterproofing Jacket: Minimum 12 mil thick, vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; UV resistant, zero permeability with textured aluminum-foil facing, impact and tear resistant.

## 2.10 DUCTWORK INSULATION ACCESSORIES

- A. Vapor Retarder Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- B. Vapor Retarder Lap Adhesive: Compatible with insulation.
- C. Adhesive: Waterproof, ASTM E162 fire-retardant type.
- D. Liner Fasteners: Galvanized steel, self-adhesive pad with head.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

- F. Lagging Adhesive: Fire retardant type with maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.
- H. Adhesives: Compatible with insulation.
- I. Membrane Adhesives: As recommended by membrane manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Protect insulation from exposure to moisture prior to and after installation. All insulation other than flexible elastomeric that becomes wet shall be replaced at no cost to the project.
- B. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- C. Verify piping, equipment and ductwork surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION - PIPING SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Piping Exposed to View in Finished Spaces Provide with PVC Plastic pipe jacketing for additional protection. Locate insulation and cover seams in least visible locations.
- D. Piping Exposed to view in mechanical spaces. Provide with PVC Plastic pipe jacketing for additional protection. Locate insulation and cover seams in least visible locations.
- E. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 for penetrations of assemblies with fire resistance rating greater than one hour.
- F. Piping Systems Conveying Fluids Below Ambient Temperature:
  - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
  - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
  - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- G. For all hot piping conveying fluids, insulate flanges and unions at equipment.

- H. Glass fiber insulated pipes conveying fluids above ambient temperature.
  - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
  
- I. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
  
- J. Insulation Terminating Points:
  - 1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
  - 2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
  - 3. Condensate Piping: Insulate entire piping system and components to prevent condensation.
  
- K. Closed Cell Elastomeric Insulation:
  - 1. Push insulation on to piping.
  - 2. Miter joints at elbows.
  - 3. Seal seams and butt joints with manufacturer's recommended adhesive.
  - 4. When application requires multiple layers, apply with joints staggered.
  - 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
  
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
  
- M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
  
- N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
  
- O. Install valve bags on all chilled water valves unless otherwise indicated. Valve bags shall be easily removable for servicing of valves.
  
- P. Prepare pipe insulation for finish painting. Refer to Division 09.

### 3.3 INSTALLATION - EQUIPMENT

- A. Factory Insulated Equipment: Do not insulate.
- B. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- D. Equipment Containing Fluids Below Ambient Temperature:
  - 1. Insulate entire equipment surfaces.
  - 2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
  - 3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
  - 4. Finish insulation at supports, protrusions, and interruptions.
- E. Equipment Containing all Fluids Above Ambient Temperature:
  - 1. Insulate flanges and unions with removable sections and jackets.
  - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
  - 3. Finish insulation at supports, protrusions, and interruptions.
- F. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.
- G. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

### 3.4 INSTALLATION - DUCTWORK SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Protect insulation from exposure to moisture prior to and after installation. All insulation other than flexible elastomeric that becomes wet shall be replaced at no cost to the project.
- D. Duct dimensions indicated on Drawings are finished inside dimensions.
- E. Insulated ductwork conveying air below ambient temperature:
  - 1. Provide insulation with vapor retarder jackets.
  - 2. Finish with tape and vapor retarder jacket.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- F. Insulated ductwork conveying air above ambient temperature:
  - 1. Provide with or without standard vapor retarder jacket.
  - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

- G. External Elastomeric Duct Insulation:
  - 1. Adhere to clean oil-free surfaces with full coverage of adhesive.
  - 2. Seal seams and butt joints with manufacturer's recommended adhesive.
  - 3. When application requires multiple layers, apply with joints staggered.
  - 4. Insulate standing metal duct seams with insulation of like material and thickness as adjacent duct surface. Apply adhesive at joints with flat duct surfaces.
  - 5. Lift ductwork off trapeze hangers and insert spacers.
  
- H. Kitchen Exhaust Ductwork:
  - 1. Cover duct by wrapping with insulation using overlap method and butt joint with collar method.
  - 2. Overlap seams of each method by 3 inches.
  - 3. Attach insulation using steel banding or by welded pins and clips.
  - 4. Install insulation without sag on underside of ductwork. Use additional fasteners to prevent sagging.
  
- I. Ducts Exterior to Building:
  - 1. Install insulation according to external duct insulation paragraph above.
  - 2. Provide external insulation with vapor retarder jacket. Cover with outdoor jacket finished with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
  - 3. Finish with aluminum duct jacket.
  - 4. Calk seams at flanges and joints. Located major longitudinal seams on bottom side of horizontal duct sections.
  
- J. Duct Acoustical Liner
  - 1. Ductwork shall still be insulated per this specification even if the ductwork is acoustically lined. Acoustically lined ductwork does not negate the use of wrap as insulation.
  
- K. Prepare duct insulation for finish painting. Refer to Division 09.

### 3.5 SCHEDULES

### 3.6 DUCTWORK SCHEDULES

- A. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Factory-insulated flexible ducts.
  - 3. Factory-insulated plenums and casings.
  - 4. Vibration-control devices.
  - 5. Factory-insulated access panels and doors.
  - 6. Stair pressurization supply ductwork.
  
- B. Provide insulation materials and thicknesses identified below. If more than one material is listed for a duct location, selection from materials listed is Division 23 option.

Heating and Cooling Supply and Heat/Energy Recovery System Exhaust Ducts Climate Zone 1, 2, 3 and 4				
Description	Minimum As-Installed R-Value	Insulation Type	Minimum Thickness (inches)	Jacketing
Exterior to building envelope	R-8.0	Closed Cell Elastomeric (CCE)	2.0	ALM
Concealed within thermal envelope of building	R-6.0	Flexible Glass Fiber (FGF)	2.0	FSK
Exposed in mechanical rooms	R-6.0	Rigid Glass Fiber (RGF)	2.0	FSK

Heating and Cooling Supply and Heat/Energy Recovery System Exhaust Ducts Climate Zone 5, 6, 7 and 8				
Description	Minimum As-Installed R-Value	Insulation Type	Minimum Thickness (inches)	Jacketing
Exterior to building envelope	R-12.0	Closed Cell Elastomeric (CCE)	3.0	ALM
Concealed within thermal envelope of building	R-6.0	Flexible Glass Fiber (FGF)	2.0	FSK
Exposed in mechanical room	R-6.0	Rigid Glass Fiber (RGF)	2.0	FSK

Unconditioned Outside Air Intake Ducts and Exhaust/Relief Duct Inside Building Envelope Climate Zones 2 Through 8				
Description	Minimum As-Installed R-Value	Insulation Type	Minimum Thickness (inches)	Jacketing
For outside air intakes, all ductwork between the building envelope and the first system heating coil, cooling coil or air handling unit connection.	R-12.0	Flexible Glass Fiber (FGF)	3.0	FSK
		Rigid Glass Fiber (RGF)	3.0	FSK
For exhaust/relief ducts, all ductwork between the building envelope and first system isolation damper.	R-12.0	Flexible Glass Fiber (FGF)	3.0	FSK
		Rigid Glass Fiber (RGF)	3.0	FSK

Oven, Dishwash, Warewash and Shower Exhaust Ducts Climate Zones 0 Through 8				
Description	Minimum As-Installed R-Value	Insulation Type	Minimum Thickness (inches)	Jacketing
Concealed in unconditioned spaces including shafts, mechanical spaces, non-plenum return ceiling cavities and crawlspaces (ventilated and non-ventilated)	R-3.5	Flexible Glass Fiber (FGF)	1.5	FSK

Concealed, Type I (Grease), Commercial, Kitchen Hood Exhaust Duct and Plenums Climate Zones 0 Through 8				
Description	Minimum As-Installed R-Value	Insulation Type	Minimum Thickness (inches)	Jacketing
All ductwork.	N/A	Fire Rated (FR)	Number of Layers and Thickness Required to Meet 2-Hour Fire Rating for Grease Ducts	N/A

3.7 DUCT LINER

- A. See Section 23 3100 - HVAC Ducts and Casings, for duct liner specifications

3.8 PIPE INSULATION SCHEDULE

- A. Provide insulation materials and thicknesses scheduled for each system type and pressure/temperature range. If more than one material is listed for a system, selection from materials listed is Division 23 option.
- B. For dual temperature systems (heating and cooling), provide thickness equal to greater of heating or cooling scheduled value. Dual temperature piping shall also meet all vapor barrier requirements for cooling insulation (perm rating).
- C. Insulation for pre-insulated piping shall meet all specified requirements.
- D. Insulate piping operating at temperatures below 40°F and systems operating between 40°F to 65°F in accordance with NAIMA Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation. Comply with all recommendations including but not limited to the requirement for vapor dams every fourth section of insulation.

Steam/Steam Condensate Return: Up to 15 PSI and 250°F					
Insulation Type	Pipe Size (inch)	Indoor - Minimum Thickness (inch)	Outdoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
Pre-Molded Glass Fiber (PGF)	Less than 1 to less than 4	2.5	4.0	ASJ-SSL	Indoor: PVC for exposed piping in finished spaces and mechanical rooms.  Outdoor: ALM
	4 and Larger	3.0	4.0		

Heating Hot Water Systems					
Insulation Type	Pipe Size (inch)	Indoor - Minimum Thickness (inch)	Outdoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
E. Pre-Molded Glass Fiber (PGF)	Less than 1 to 1.5	1.5	3.0	ASJ-SSL	Indoor: PVC for exposed piping finished space and mechanical rooms.  Outdoor: ALM
F.					

	1.5 and Larger	2.0	4.0		
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Cooling and Glycol Energy Recovery Systems: 40 deg F to 65 deg F Applies to the Following Systems: Chilled Water					
Insulation Type	Pipe Size (inch)	Indoor - Minimum Thickness (inch)	Outdoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
G. Closed Cell Elastomeric (CCE)	Less than 1 to 1.5	0.5	3.0	N/A	Indoor: PVC for exposed piping finished space and mechanical rooms  Outdoor: ALM
	1.5 and Larger	1.0	3.0		

All Outdoor Heat Traced Piping				
Insulation Type	Pipe Size (inch)	Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
H. Pre-Molded Glass Fiber (PGF)	Less than 1	1.25*	ASJ-SSL	Outdoor: ALM
	1 to Less than 1.5	1.5*		
	1.5 to 2	2.0*		
	2.5 to 3	3.0*		
	4	4.0*		

1. \*Insulation thickness to be determined by heat trace manufacturer installation instructions

Cooling Coil Condensate Piping, Outdoor Cooling Tower Makeup Water Piping and Equipment Drain Piping: All					
Insulation Type	Pipe Size (inch)	Indoor - Minimum Thickness (inch)	Outdoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
I. Closed Cell Elastomeric (CCE)	All Sizes	0.75	2.0	N/A	Indoor (CCE): N/A Outdoor (CCE): ALM

Refrigerant Piping					
Insulation Type	Pipe Size (inch)	Indoor - Minimum Thickness (inch)	Outdoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
Closed Cell Elastomeric (CCE)	Less than 3	1.0	1.0	N/A	Indoor: N/A Outdoor: ALM

3.9 EQUIPMENT INSULATION SCHEDULE

- A. Provide insulation materials and thicknesses scheduled for each system type and pressure/temperature range. If more than one material is listed for a system, selection from materials listed is Division 23 option.

Chilled Water: Pump Bodies, Air Separators, Expansion Tanks				
Insulation Type	Indoor - Minimum Thickness (inch)	Outdoor - Minimum Thickness (inch)	Factory Applied Jacket	Field Applied Jacket
Closed Cell Elastomeric (CCE)	1.0	1.5	N/A	Indoor: N/A Outdoor: ALM

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROLS FOR HVAC

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. System Description
- B. Thermostats
- C. Humidistats
- D. Time Clocks
- E. Dampers
- F. Actuators
- G. Wire, Cable And Network Accessories

1.3 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This Section includes provision of control sequences for HVAC systems, subsystems, and equipment indicated on the drawings and other Division 23 specification sections.
- C. Section 23 0400 – General Conditions for Mechanical Trades.
- D. Section 26 2717 – Equipment Wiring: Electrical characteristics and wiring connections.
- E. Section 28 3100 – Fire Detection and Alarm.

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. ANSI/CEA 709.1.D - Control Network Protocol Specification.
- B. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.
- C. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; Revision G.

- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL (DIR) - Online Certifications Directory.

#### 1.5 GENERAL REQUIREMENTS

- A. All work of this section shall be coordinated and provided by the single Contractor.
- B. Contractor shall be responsible for wiring all manufacturer provided controls that require field mounting for DOAS-1 and the VRF systems including, but not limited to, temperature sensors, humidity sensors, actuators, and other control components required to achieve the sequence of operation noted on the drawings.
- C. Provide the services of manufacturer's representative to be on site during startup, testing and balancing procedures, detailed in Part 3 of this specification. Representative shall be part of manufacturer's service organization and shall be skilled in the adjustment and calibration of all control devices as well as being capable of modifying and checking system software.

#### 1.6 ADMINISTRATIVE REQUIREMENTS

- A. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades.
- B. If the Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.
- C. Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- D. Scheduling: Coordinate with Owner and General Contractor. Manage and coordinate the work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

#### 1.7 COORDINATION

- A. Coordinate locations of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate work under provisions of General Conditions and Division 1 as applicable.
- C. Coordinate material delivery to comply with project schedule.
- D. Coordinate conduit, and wiring installation with other trades to avoid conflicts.
- E. Coordinate panel locations and installation with other trades to avoid conflicts and to provide power and other requirements.

## 1.8 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
- B. Shop Drawings: Submit shop drawings containing the following information for each control system:
  - 1. System architecture diagram: Indicate programmable control unit locations, and trunk data conductors.
  - 2. Schematic control diagrams: Submit diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
  - 3. Floor plans: Show sizes and locations of components, horizontal routing and risers.
  - 4. Points list: List connected data points, including connected control unit and input device.
  - 5. Sequence of operation: Written detailed operational description of sequences
  - 6. Schedule of dampers: Include size, leakage, pressure drop and other flow characteristics.
  - 7. Schedule of valves: Including flow, pressure drop, valve coefficient (CV), shut-off head, maximum controllable differential pressure range and other flow characteristics.
- C. Wiring Diagrams: Submit wiring diagrams, detailing wiring for power, signal, and control systems and differentiating clearly between manufacturers installed and field installed wiring.
- D. Sample Covers: Submit samples of each type of space sensor cover for approval prior to ordering the covers.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owners name and registered with manufacturer.

## 1.9 RECORD DOCUMENTATION

- A. General: Manuals shall be furnished as files in portable document format (PDF). One complete set of manuals shall be furnished before the contract is complete. The manuals shall include the name, address and telephone number of each subcontractor installing equipment and systems and of the local representative for each specific item of equipment and each system provided. A logically organized table of contents shall be included with dynamic links to view all data sheets.
- B. Hardware Manual: The hardware manual shall describe the system and each piece of equipment provided.
- C. Software Manual: The software manual shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software module. The manual shall be oriented to programmers and shall describe calling requirements, data exchange requirements, data file requirements, and other information necessary to enable proper integration, loading, testing, and program execution.
- D. Operations Manual: The Operations manual shall describe the operations of the complete system.

- E. Maintenance Manual: The maintenance manual shall provide descriptions of maintenance for each piece of equipment, including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.
- F. Project Drawings: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors. Revise shop drawings to reflect actual installation and operating sequences.

#### 1.10 QUALITY ASSURANCE

- A. Products shall be standard manufacturer products having been in commercial or industrial use for at least one year prior to the bid date for this project. Products shall comply with the following as a minimum:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
  - 2. NISTIR 6392 for digital system control components.
  - 3. ANSI/ASHRAE Standard 135-1995 for BACnet compatible system control components.
  - 4. Applicable provisions of NFPA code.
  - 5. Applicable provisions of NEC.
- B. Designer Qualifications: Perform design of system software under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- E. 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 certified and marked for intended use.
- F. Comply with ASHRAE 135 for system components.

#### 1.11 PERFORMANCE REQUIREMENTS

- A. Accuracy: Report values and maintain measured variables within tolerances as follows:
  - 1. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
  - 2. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
  - 3. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
  - 4. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
  - 5. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
  - 6. Relative Humidity: Plus or minus 5 percent.
  - 7. Airflow (Terminal): Plus or minus 10 percent of full scale.
  - 8. Electrical: Plus or minus 5 percent of reading.

#### 1.12 WARRANTY

- A. Correct defective Work within a five-year period after Substantial Completion.

## PART 2 PRODUCTS

### 2.1 THERMOSTATS

- A. General: Refer to control sequences and diagrams for application requirements. Manufacturer's standard thermostats shall meet the applicable requirements listed below, unless thermostat is specified in other sections.
- B. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," or "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box. Separate heating and cooling setpoint with locking exposed setpoint adjustment. Automatic switching from heating to cooling.
- C. Electric microcomputer-based room thermostats: 7-day programmable with automatic switching from heating to cooling, short-cycle protection, battery replacement without program loss, LCD display including room temperature, setpoint and mode.
- D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated mercury-switch type, with adjustable anticipation heater.
- E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch. Thermostats that control electric heating loads directly shall be provided with off position on dial wired to break ungrounded conductors.
- F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.
  - 1. Bulbs in water lines with separate wells of same material as bulb.
  - 2. Bulbs in air ducts with flanges and shields.
  - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
  - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
  - 5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
  - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- G. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, with the following:
  - 1. Compliant with latest issue of NFPA 90A.
  - 2. Reset: Manual
  - 3. Dual-Temperature Thermostats: Automatic changeover from normal setting to lower unoccupied setting, with manual-reset lever to permit return to normal temperatures during unoccupied cycles, with automatic reset to normal during next cycle of operation.
- H. Immersion Thermostats: Remote-bulb or bimetal rod-and-tube type, proportional acting with adjustable throttling range and adjustable set point.
- I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in air gauge

test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

- J. Heating/Cooling Valve-Top Thermostats: Proportional acting for modulating flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct or reverse acting with minimum valve shutoff differential pressure of 25 psig, and cast housing with position indicator and adjusting knob.

## 2.2 HUMIDISTATS

- A. Electric Duct-Mounted Humidistats: Insertion, 2-position type with adjustable 2 percent throttling range, 20 to 80 percent operating range, single- or double-pole contacts.

## 2.3 TIME CLOCKS

- A. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.
- B. Solid state programmable time control, 24 hour battery carry over, duty cycling.

## 2.4 DAMPERS

- A. General: The Contractor shall furnish all automatic dampers unless provided as standard from equipment manufacturer. All automatic dampers shall be sized for the application by the Contractor or as specifically indicated on the Drawings.
- B. Sizing and Application: All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear. All dampers used for two-position, open/close control and mixing boxes shall be parallel blade type arranged for normally open or closed operation, as required.
- C. One-Piece Rolled Blade Damper
  1. Manufacturers:
    - a. Johnson Controls D-1600
    - b. Ruskin CD36
    - c. Vent Products 5800
    - d. Tamco
  2. Performance: Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
  3. Construction:
    - a. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage, 0.1046 inch.
    - b. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, 0.0299 inch, attached to minimum 1/2 inch shafts with set screws.
    - c. Blade Seals: Synthetic elastomeric inflatable mechanically attached, field replaceable.
    - d. Jamb Seals: Spring stainless steel.

- e. Shaft Bearings: Oil impregnated sintered bronze.
- f. Linkage Bearings: Oil impregnated sintered bronze.
- 4. Application: face velocities of 1500 FPM or below.

## 2.5 ACTUATORS

- A. General: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action over the entire operating range. Provide proportional or two-position type as indicated in the sequence of operation, with current limiting circuitry or microprocessor overload protection.
- B. Manufacturers:
  - 1. Johnson Controls
  - 2. Honeywell
  - 3. Belimo
  - 4. Siemens
- C. Electronic Damper Actuators
  - 1. Modulating and two-position actuators shall be provided as required by the sequence of operations and as indicated on drawings. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.
  - 2. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
  - 3. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
  - 4. Electronic damper actuators shall be direct shaft mount.

## 2.6 WIRE, CABLE AND NETWORK ACCESSORIES

- A. Exposed cables installed in air plenums shall be specifically listed for air plenum use. (See specifications for specific wire and cable installation requirements.)
- B. Cables, both fiber and copper, shall be as recommended by the manufacturer of the control system, and shall be as required to support the specified transmission type.
- C. Network Repeater: Provide network repeaters as required to isolate and boost RS-485 signals. Provide power connection and NEMA enclosure as required.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

### 3.2 INSTALLATION

- A. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- B. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- C. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- D. Provide with 120v AC, 15 amp dedicated power circuit to each controller.
- E. Provide conduit and electrical wiring in accordance with Section 26. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- F. Furnish and install all access doors.
- G. Control Wiring
  - 1. All conduit, wiring, accessories and wiring connections required for the installation of the control system, as herein specified, shall be provided by the Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
  - 2. All wiring materials and installation methods shall comply with manufacturer requirements.
  - 3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
  - 4. Class 2 Wiring
    - a. All exposed 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 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
    - c. The use of plenum rated cable, not in conduit, in areas such as drop ceilings and wall cavities is acceptable.

- d. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
  - 5. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- H. Line Voltage Power Source
- 1. 120-volt AC circuits used for the system shall be taken from panel boards and circuit breakers provided by Division 26.
- I. Raceway
- 1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 3/4".
  - 2. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
  - 3. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- J. Penetrations
- 1. Provide fire stopping for all penetrations used by dedicated conduits and raceways.
  - 2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
  - 3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
  - 4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
- K. Identification Standards
- 1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
    - a. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.
- L. Control Panel Installation
- 1. The panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
  - 2. The contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

### 3.3 COMMISSIONING

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. The Contractor shall provide the services of a factory authorized service representative to assist an independent commissioning agent to start up the control systems, and to commission each component included in the system.
- C. Controls and Safeties: Test, and set each of the digital and analog sensing and actuating devices. Test each instrumentation device by making a comparison between the central

computer or field control panel display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be tested. Record the measured value and displayed value for each device in the Commissioning Report.

- D. Operational Tests: The Contractor shall conduct an operational test of each system and subsystem, including each of the associated field control panels, components, and field devices, to verify the proper sequence of operation and the actual performance of the installed subsystem.
- E. Documentation: Provide written documentation of the system commissioning and performance verification processes described above, including an itemized inspection and validation report complete with dates and second test results, and a performance test report for each system and each Sequence of Operation.

### 3.4 DEMONSTRATION AND INSTRUCTIONS

- A. General: The contractor shall demonstrate the operation of hardware, software, and each of the related components, systems and subsystems to the satisfaction of the Owner. The Contractor shall schedule the demonstration with the Owner's representative at least 2 weeks in advance of the proposed demonstration. Demonstration shall not be scheduled until each of the hardware and software submittals, and the Commissioning Test Report are received and approved. If the work fails to conform to Contract specifications, scheduling of additional site visits by the Contractor for re-demonstration is required.
- B. Personnel and Equipment: The Contractor shall supply the required personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, paper, etc. The contractor-supplied personnel shall be competent with and knowledgeable of the project-specific hardware, software, and the HVAC systems. Complete training documentation and a complete copy of the submittals shall be on file at the job site.
- C. Physical Demonstration of Response to System Conditions: System acceptance shall include demonstrations that each of the components function properly by actual response to system conditions that may be encountered. The Contractor shall furnish the materials such as sources of temporary heating and cooling necessary to cause the system components to go through the required sequences. Computer simulations of possible operating conditions are not acceptable for demonstration of system performance. Proposed methods of demonstrating component operation shall be submitted to the Owner. Representatives of Owner will also witness the tests.
- D. Orientation and training: Provide services of qualified technical personnel for two 8-hour days at project site to instruct Owner's personnel in operation and maintenance of the installed control system.

### 3.5 ACCEPTANCE

- A. Upon completion of the installation and commissioning of the systems, the contractor shall notify the owner's representative in writing, together with a copy of the commissioning report, that the system is complete and ready for acceptance testing. The owner's representative shall schedule a starting day for system acceptance testing. The contractor shall demonstrate calibration, testing, and adjusting of points or systems selected by the owner's representative. After an adequate sampling of points and sequences have been verified to satisfy the owner's representative that the system is

performing in accordance with the contract documents, the system shall be accepted and the warranty period shall begin.

### 3.6 MAINTENANCE

- A. See Section 01 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.
- C. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.
- D. Provide complete service of systems, including service calls to inspect, calibrate, and adjust controls, and submit written reports.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Condensate piping.
- B. Equipment drains and over flows.
- C. Unions and flanges.

1.3 RELATED SECTIONS

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

1.4 REFERENCES

- A. American Society of Mechanical Engineers:
  - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - 3. ASME B31.9 - Building Services Piping.
  - 4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. ASTM International:
  - 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  - 3. ASTM B32 - Standard Specification for Solder Metal.
  - 4. ASTM B75 – Standard Specification for Seamless Copper Tube.
  - 5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
  - 6. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
  - 7. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

8. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
9. ASTM D2241 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
10. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
11. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
12. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
13. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
14. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
15. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
16. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
17. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
18. ASTM F441/F441M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
19. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
20. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
21. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot-and Cold-Water Distribution Systems.
22. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

1.5 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and Grooved coupling couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate layout of piping system, including equipment, critical dimensions, and sizes.

1. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable Grooved coupling style or series number.
  - B. Product Data:
    1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
  - C. Test Reports: Indicate results of piping system pressure test.
  - D. Welders' Certificates.
- 1.7 CLOSEOUT SUBMITTALS
- A. Project Record Documents: Record actual locations of valves equipment and accessories.
- 1.8 QUALITY ASSURANCE
- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
  - B. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
  - C. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.
- 1.9 QUALIFICATIONS
- A. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience.
  - B. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
  - B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT DRAINS, CONDENSATE PIPING AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type L, drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
  2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
- B. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

#### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

#### 3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install pipe hangers and supports in accordance with Section 23 05 29.

#### 3.4 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install Work in accordance with Owner's guidelines.
- B. Route piping parallel to building structure and maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- F. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- G. Install pipe identification in accordance with Section 23 05 53.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- I. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- J. Slope hydronic piping and arrange systems to drain at low points.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- L. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Insulate piping and equipment; refer to Section 23 07 00.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) recommended by the manufacturer. Contractor shall be trained on the use and installation of the system by manufacturer's representative.

### 3.6 HANGERS AND SUPPORTS

- A. Comply with requirements in Division 23 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2 (Note 1)	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4
8	16	19	3/4	3/4
10	18	22	3/4	7/8
12	19	23	3/4	7/8
14	22	25	7/8	1
16	23	27	7/8	1
18	25	28	1	1
20	27	30	1	1-1/4
24	28	32	1-1/4	1-1/4

- B. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES:

- A. Duct Materials.
- B. Duct Liner.
- C. Insulated flexible ducts.
- D. Ductwork fabrication.

1.3 RELATED SECTIONS

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

1.4 REFERENCES

- A. ASTM International:
  - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
  - 3. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 4. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - 5. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
  - 6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 7. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

8. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
  9. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  10. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
  11. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
  12. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
  2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
  3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- C. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - Fibrous Glass Duct Construction Standards.
  2. SMACNA - HVAC Air Duct Leakage Test Manual.
  3. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- D. Underwriters Laboratories Inc.:
1. UL 181 - Factory-Made Air Ducts and Connectors.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" beef up duct hanger and support in this section.
- C. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

## 1.6 SUBMITTALS

- A. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.

2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire rated and other walls.
7. Terminal unit, coil, and humidifier installations.
8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

B. Product Data: Submit data for duct materials, duct liner, duct connectors .

C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

#### 1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### 1.8 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards as applicable.

#### 1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

#### 1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

#### 1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

## PART 2 PRODUCTS

### 2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 (zinc coating of in conformance with ASTM A90/A90M).
- B. Steel Ducts: ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
- C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength. Mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Stainless Steel Ducts: ASTM A480/A480M, Type [304.] [316.] Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article
- E. Fasteners: Rivets, bolts, or sheet metal screws.
- F. Hanger Rod: ASTM A36/A36M; steel , galvanized; threaded both ends, threaded one end, or continuously threaded.

### 2.2 DUCT LINER

- A. Fibrous-Glass Duct Liner
  - 1. Manufacturers:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
  - 2. Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.3 INSULATED FLEXIBLE DUCTS

- A. Manufacturers:
  - 1. Thermaflex
  - 2. Technaflex
  - 3. Tuttle + Bailey
  - 4. Flexmaster

- B. Product Description: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helical wound spring steel wire; fiberglass insulation; polyethylene or aluminized vapor barrier film.
  - 1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
  - 2. Maximum Velocity: 4000 fpm.
  - 3. Temperature Range: -20 degrees F to 210 degrees F.
  - 4. Thermal Resistance: 6square feet-hour-degree F per BTU.
  - 5. Vapor Barrier Permeance: 0.05 perm per ASRM E96, Procedure A

## 2.4 SEALANTS AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. General: Brush-on, water-resistant, mold and mildew resistant, indoor and outdoor use, compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. VOC: Maximum 75 g/L (less water).
  - 5. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

## 2.5 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible . Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards). Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. TDC connections on all ductwork where any dimension exceeds 12 inches. Slip and drive connection acceptable on duct sizes less than 12" x 12".

- D. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide [airfoil] turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- G. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- H. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems.
  - 1. Sealants, Mastics: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
  - 2. Do not provide sealing products not bearing UL approval markings.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

#### 3.2 INSTALLATION

- A. General:
  - 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
  - 2. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - 3. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
  - 4. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8inch and smaller.
  - 5. Install duct hangers and supports in accordance with Section 23 05 29.
  - 6. Use double nuts and lock washers on threaded rod supports.
  - 7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
  - 8. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

9. Do not route ducts through transformer vaults or electrical equipment rooms and enclosures.
10. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
11. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23, Air Duct Accessories for fire and smoke dampers.

**B. Flexible ductwork**

1. When located above ceilings, support flexible duct from above; flexible duct shall not touch the ceiling.
2. Minimize kinks and sags
3. Flexible duct shall be located only where concealed and accessible.
4. Non-insulated flexible ductwork: Provide when the metal ductwork connected to is not insulated.
5. Insulated flexible ductwork: Provide when the metal ductwork connected to is insulated. R-value of flexible ductwork insulation shall meet or exceed the R-value of the metal ductwork insulation.
6. Elbow supports: Provide above flexible ductwork connections to ceiling diffusers. Use cable ties as indicated in the manufacturer's installation instructions.
7. Connections to rigid ductwork: Provide both a drawband and two layers of duct tape lapped approximately 25% at each connection of flexible ductwork to rigid ductwork. Drawbands shall be the non-metallic type listed and labeled in accordance with UL 181B. Duct tape shall be listed and labeled in accordance with UL 181B.

**3.3 DUCT SEALING**

**A. Duct Seal Level Description**

Seal Level	Sealing Requirements*
A	All transverse joints, longitudinal seams, and duct wall penetrations. Pressure sensitive tape shall not be used as the primary sealant, unless it has been certified to comply with UL-181A or UL0181B by an independent testing laboratory and the tape is used in accordance with that certification
B	All transverse joints, longitudinal seams. Pressure sensitive tape shall not be used as the primary sealant, unless it has been certified to comply with UL-181A or UL0181B by an independent testing laboratory and the tape is used in accordance with that certification.
C	Transverse joints only.
<p>Notes:</p> <p>Longitudinal seams are joints oriented in the direction of flow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw fastener, pipe, rod, or wire. Spiral lock seams in a round or flat oval duct need not be sealed. All other connections are considered transverse joints, including but not limited to spin-ins, taps, and other branch connections,</p>	

access door frames and jambs, duct connections to equipment, etc.

B. Minimum Duct Seal Levels

Duct Type				
Duct Location	Supply		Exhaust	Return
	2-in. or less (1)	Greater than 2-in. (1)		
Unconditioned Space (2)	B	A	C	B
Conditioned Space	C	B	B	C
Notes:				
Duct design static pressure classification				
Includes indirectly conditioned spaces such as return air plenums				

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect air terminal units to supply ducts directly or with five foot maximum length of flexible duct. Do not use flexible duct to change direction.

3.5 CLEANING

- 1. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Duct cleaning is required if test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." do not meet the following criteria:
  - 1. Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- D. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.6 DUCTWORK LEAKAGE TESTING

- A. The following ductwork systems shall be pressure/leakage tested:

1. All ductwork to be concealed in a sheetrock, concrete block or other permanent chase shall be pressure tested before ductwork is concealed.
  2. 2012 IECC REQUIREMENTS
    - a. Representative sections totaling no less than 25% of ductwork systems listed below that are constructed and installed for 3" w.c. or more (positive or negative).]
  3. For ductwork leakage testing: "Ductwork main" shall be defined as all ductwork serving more than one grille or diffuser.
  4. All ductwork outside of the building insulation envelope shall be pressure tested.
- B. Testing shall conform to the following:
1. Test static pressure must be the lower of 125% of the external static pressure of the air moving equipment or the construction static pressure class of the ductwork.
  2. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Maximum Allowable Leakage shall be in accordance with Duct Pressure Class rating listed below and Leakage Class listed here-in.
  3. For Ductwork Pressure Class 3" w.c: Leakage Class shall be 8.
  4. For Ductwork Pressure Class 2" w.c or less: Leakage Class shall be 16.
  5. Testing shall occur after ductwork has been cleaned, but before duct insulation is applied or ductwork is concealed.
- C. Duct Leakage Test Report shall include:
1. Date of test.
  2. Name of company and person conducting the test.
  3. Name of company and person witnessing the test.
  4. Description of ductwork tested. Provide drawings to indicate section of ductwork being tested. Labeling on the drawings shall correspond to labeling in the report.
  5. Surface area (square feet) of section of ductwork being tested.
  6. Duct design operating pressure (inches w.c.)
  7. P = Duct design test static pressure (inches w.c.)
  8. Duct capacity, air flow
  9. CL= Specified Leakage Class.
  10. F = Leakage factor (CFM / 100 sf of duct area)
  11. Maximum allowable leakage (CFM)
  12. Test apparatus
    - a. Blower
    - b. Orifice tube size
    - c. Orifice size
    - d. Calibrated
  13. Test orifice differential pressure (inches w.c.)

3.7 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply, Return, Exhaust, Outside Air	Galvanized Steel.

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
------------	----------------

Supply Ductwork	3 inch wg
Return, Exhaust, Outside Air	2 inch wg regardless of velocity.

C. Ductwork Liner Schedule:

AIR SYSTEM	THICKNESS
10 ft downstream of VRF fan coil unit	1 inch

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES:

- A. Back-draft dampers.
- B. Duct access doors.
- C. Volume control dampers.
- D. Flexible duct connections.
- E. Duct test holes.

1.3 RELATED SECTIONS:

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 23 05 19 – Meters and Gauges
- C. Section 23 04 00 – General Conditions for Mechanical Trades
- D. Section 23 09 23 - Direct-Digital Control System for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
- E. Section 23 31 00 - HVAC Ducts: Requirements for duct construction and pressure classifications.
- F. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.4 REFERENCES (follow the most currently adopted amended version)

- A. Air Movement and Control Association International, Inc.:
  - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

- B. ASTM International:
  - 1. ASTM E1 - Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
  - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
  - 2. NFPA 92A - Recommended Practice for Smoke-Control Systems.
- D. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- E. Underwriters Laboratories Inc.:
  - 1. UL 555 - Standard for Safety for Fire Dampers.
  - 2. UL 555C - Standard for Safety for Ceiling Dampers.
  - 3. UL 555S - Standard for Safety for Smoke Dampers.

## 1.5 SUBMITTALS

- A. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- B. Product Data: Submit data for shop fabricated assemblies and hardware used.
- C. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
  - 1. Fire dampers including locations and ratings.
  - 2. Smoke dampers including locations and ratings.
  - 3. Backdraft dampers.
  - 4. Flexible duct connections.
  - 5. Volume control dampers.
  - 6. Duct access doors.
  - 7. Duct test holes.
- D. Product Data: For fire dampers, smoke dampers, combination fire and smoke dampers submit the following:
  - 1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
  - 2. Indicate materials, construction, dimensions, and installation details.
  - 3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- E. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

## 1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of access doors test holes and dampers.

- B. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

#### 1.7 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- C. Maintain one copy of each document on site.

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

#### 1.9 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.
- B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- C. Storage: Store materials in a dry area indoor, protected from damage.
- D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

#### 1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.12 COORDINATION

- A. Coordinate Work where appropriate with building control Work.

#### 1.13 WARRANTY

- A. Furnish five-year manufacturer warranty for duct accessories.

#### 1.14 EXTRA MATERIALS

- A. Fusible Links: Furnish quantity equal to 10 percent of number installed.

## PART 2 PRODUCTS

### 2.1 BACK-DRAFT DAMPERS

- A. Manufacturers:
1. Ruskin CB series
  2. Price BDD Series
  3. Greenheck EM Series
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, extruded aluminum. Blades, maximum 6 inch width, center pivoted, with flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

### 2.2 DUCT ACCESS DOORS

- A. Manufacturers:
1. Ruskin
  2. Elgen
  3. Greenheck
  4. Buckley
  5. Kees
  6. Pottorff
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
- C. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover.
1. Less than 12 inches square, secure with sash locks.
  2. Up to 18 inches Square: Furnish two hinges and two sash locks.
  3. Up to 24 x 48 inches: Three hinges and two compression latches.
  4. Larger Sizes: Furnish additional hinge.
  5. Access panels with sheet metal screw fasteners are not acceptable.
- D. Materials
1. Aluminum construction: Minimum 0.032" thick aluminum double wall door, minimum 0.032" thick aluminum frame. Provide for aluminum duct.
  2. Steel construction: Minimum 24 gauge galvanized double wall door, minimum 24 gauge galvanized frame. Provide for galvanized steel duct.
  3. Stainless steel construction: Minimum 24 gauge stainless steel double wall door, minimum 22 gauge stainless steel frame. Provide for stainless steel or aluminum duct.
- E. Low Pressure Rectangular (Non-Grease-Ducts):

1. Door: For insulated ducts, provide double wall door with 1" or 2" insulation cavity – as necessary to accommodate required insulation. For non-insulated ducts, provide single wall door.
  2. Gasket: Closed cell neoprene.
  3. Hardware: Double (opposite side) cam latches or single cam latch with full length (piano style) hinge.
  4. Insulation: Glass fiber type, 1" thick for ductwork with up to 1" thick acoustical lining or insulation wrap, 2" thick for ductwork with 1-1/2" and over acoustical lining or insulation wrap.
- F. Low Pressure Round & Oval Duct (Non-Grease Ducts),
1. Insulated duct, low pressure (3" wg): Welded construction, 18 gauge galvanized steel, 24 gauge galvanized double wall door, double cam latches or single cam latch with full length (piano style) hinge, 2" thick glass fiber insulation.
  2. Non-Insulated duct, low pressure (6" wg): 16 gauge galvanized door, plated steel full length (piano style) hinge, zinc plated draw latch(es) and keeper(s), closed cell neoprene gasket.

### 2.3 VOLUME CONTROL DAMPERS

- A. Manufacturers:
1. Ruskin
  2. Nailor
  3. Greenheck
  4. Flexmaster
  5. McGill Airflow
  6. Nailor
  7. Pottorff
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Splitter Dampers:
1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.
  2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  3. Operator: Minimum 3/8 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
  4. Single Blade Dampers: Fabricate for duct sizes up to 12 x 48 inch.
- D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.
- E. End Bearings: Except in round ductwork 12inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg..
- F. Quadrants:

1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches furnish regulator at both ends.

## 2.4 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
1. Ventfabrics Inc. Ventglas
  2. United McGill
  3. Elgen
  4. DuroDyne
  5. Ventfabrics
  6. Ductmate Industries
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of galvanized or aluminum sheet steel. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
  2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg F.

## 2.5 DUCT TEST HOLES

- A. Manufacturers:
1. Dwyer
  2. Flow Kinetics
  3. Air Balance
  4. Substitutions: Division 01 - General Requirements.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

## 2.6 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
1. Pottorff.
  2. Ventfabrics, Inc.
  3. Young Regulator Company.

- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass, Copper or Aluminum.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Painted steel.

## 2.7 TURNING VANES

- A. Manufacturers:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Elgen Manufacturing.
  - 4. METALAIRE, Inc.
  - 5. SEMCO Incorporated.
  - 6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment installation are ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

### 3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Install motorized back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated on Drawings.

- C. Access Doors: Install access doors of type suitable for application at the following locations:
1. Spaced every 50 feet of straight duct.
  2. Upstream of each elbow.
  3. Upstream of each reheat coil.
  4. Before and after each duct mounted filter.
  5. Before and after each duct mounted coil.
  6. Before and after each duct mounted fan.
  7. Before and after each automatic control damper.
  8. Before and after each fire damper, smoke damper, combination fire and smoke damper.
  9. Downstream of each VAV box.
  10. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96.
- D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
1. Mark access doors for fire and smoke dampers on outside surface, with minimum 1/2 inch high letters reading: FIRE/SMOKE DAMPER, SMOKE DAMPER, OR FIRE DAMPER.
- E. Install temporary duct test holes and required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- F. Install fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings and as indicated in specifications. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges. Install dampers and accessories with required clearance for access. Provide all power and control wiring for a complete and operable system.
1. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.
  2. Install dampers square and free from racking with blades running horizontally.
  3. Do not compress or stretch damper frame into duct or opening.
  4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
  5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

### 3.3 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

1.3 RELATED REQUIREMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 09: Painting
- C. Section 23 04 00 – General Conditions for Mechanical Trades
- D. Section 23 33 00 – Air Duct Accessories.

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating
- B. AMCA 511 - Certified Ratings Program for Air Control Devices.
- C. AMCA 540 – Debris Impact Resistance
- D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers.
- E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

## 1.5 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- B. Project Record Documents: Record actual locations of all air outlets and inlets.
- C. Project Record Documents: Once the final Testing, Adjusting & Balancing Report is approved, record all typed airflow values on the as-built drawings.
- D. Test Reports: Rating of air outlet and inlet performance.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements

## 1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

## 1.7 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.
- C. AMCA 540 – Debris Impact Resistance
- D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2015.
- E. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- F. Maintain two copies of each document on site.

## 1.8 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

## 1.9 WARRANTY

- A. Furnish five year manufacturer warranty for air outlets and inlets.

## 1.10 EXTRA MATERIALS

- A. Furnish one of each type and size extra air outlets and inlets.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. The following list of manufacturers applies to all air terminal units unless otherwise noted in sections below.
  - 1. Price Industries

2. Titus
3. Krueger
4. Nailor Industries
5. Anemostat

## 2.2 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square, stamped, multi-core, square, adjustable pattern, stamped, multi-core, square and rectangular, multi-louvered, square and rectangular, adjustable pattern, multi-louvered, and diffuser to discharge air in 360 degree, one way, two way, three way, four way, and pattern with directional baffles where indicated.
- B. Connections: Round.
- C. Frame: Provide surface mount, snap-in, inverted T-bar, spline type. In plaster ceilings, provide plaster frame and ceiling frame.
- D. Fabrication: Steel with baked enamel finish.
- E. Color: As selected by Architect from manufacturer's standard range.
- F. Accessories: Refer to schedule.

## 2.3 CEILING SLOT DIFFUSERS

- A. Type: Continuous wide slot, with adjustable vanes for left, right, or vertical discharge, refer to schedule
- B. Fabrication: Aluminum extrusions with factory clear lacquer finish.
- C. Color: To be selected by Architect from manufacturer's standard range.
- D. Frame: Refer to schedule.
- E. Plenum: Integral, galvanized steel, insulated.

## 2.4 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Refer to schedule.
- B. Frame: Refer to schedule.
- C. Color: To be selected by Architect from manufacturer's standard range.
- D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling, wall systems are ready for installation.

#### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly. Refer to Section 23 33 00.
- F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09.

#### 3.3 AIR OUTLET AND INLET SCHEDULE

- A. Refer to drawing schedules.

#### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

SECTION 237300

INDOOR AIR HANDLING UNITS

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section includes modular factory fabricated air-handling units and accessories.
- B. Related Sections:
  - 1. Division 03 - Cast-In-Place Concrete: Execution requirements for housekeeping pads specified by this section.
  - 2. Section 23 0400 – General Conditions for Mechanical Trades
  - 3. Section 23 0513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
  - 4. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
  - 5. Section 23 0700 - HVAC Insulation: Product requirements for insulation for placement by this section.
  - 6. Section 23 0900 - Direct-Digital Control System for HVAC: Controls remote from unit.
  - 7. Section 23 0993 - Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.
  - 8. Section 23 2113 - Hydronic Piping: Product requirements for chilled water and hot water piping connections to air handling units.
  - 9. Section 23 2116 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.
  - 10. Section 23 3300 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
  - 11. Section 26 0503 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
  - 12. Section 26 2923 - Variable-Frequency Motor Controllers: Variable frequency controllers.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
  - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
  - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
  2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
  4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
  5. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. Air-Conditioning and Refrigeration Institute:
1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
  2. ARI 430 - Central-Station Air-Handling Units.
  3. ARI 610 - Central System Humidifiers for Residential Applications.
  4. ARI Guideline D - Application and Installation of Central Station Air-Handling Units.
- D. National Electrical Manufacturers Association:
1. NEMA MG 1 - Motors and Generators.
- E. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. Underwriters Laboratories Inc.:
1. UL 900 - Air Filter Units.
  2. UL - Fire Resistance Directory.

#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.
- C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- D. Product Data, Submit the following:
1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
  2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
  4. Sound data shall be provided using ARI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz.
  5. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.
  6. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- E. Samples: Submit two of each type of replacement filter media with frame.

- F. Manufacturer's Installation Instructions: Submit.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### SUBSTITUTIONS

- H. Refer to specification 230400 for all substitution procedures.
- I. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Engineers/Architects of Record at the expense of the Contractor and at no additional cost to the Owner.

### 1.5 REGULATORY REQUIREMENTS

- A. Agency Listings/Certifications
  - 1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL/CUL or ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL/CUL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the owner.
  - 2. Certify air handling units in accordance with ARI Standard 430. Units shall be provided with certification label affixed to the unit. If air handling units are not certified in accordance with ARI Standard 430, contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.
  - 3. Certify air handling coils in accordance with ARI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with ARI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.
  - 4. Certify airflow monitoring stations are tested for differential pressure in accordance with AMCA 611 in an AMCA registered laboratory and comply with the requirements of the AMCA Certified Ratings Program. Airflow monitoring station shall be licensed to bear the AMCA Seal.

### 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 QUALITY ASSURANCE

- A. Damper Leakage: Test in accordance with AMCA 500.
- B. Perform Work in accordance with State of Massachusetts standard.
- C. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Protect units from weather and construction traffic by storing in dry, roofed location.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of five years from unit start-up. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

1.12 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of fan belts for each unit.
- C. Furnish one set of filters for each unit.

## PART 2 PRODUCTS

### 2.1 AIR HANDLING / DEDICATED OUTDOOR AIR UNITS AND ACCESSORIES (DOAS-1)

- A. Manufacturers:
  - 1. AAON.
  - 2. Addison.
  - 3. Daikin Applied.

### 2.2 GENERAL DESCRIPTION

- A. Indoor air handling units shall include filters, supply fans, DX evaporator coil, hot gas reheat, mixing box, exhaust fans, and energy recovery wheels.
- B. Unit shall have a draw-through supply fan configuration and discharge air vertically.
- C. Unit shall be factory assembled and tested including leak testing of the coils and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.
- D. Unit shall have decals and tags to indicate lifting and rigging, service areas, and caution areas for safety and to assist service personnel.
- E. Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
- F. Installation, Operation and Maintenance manual shall be supplied within the unit.
- G. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's access door.
- H. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's access door.

### 2.3 CONSTRUCTION

- A. All cabinet walls and access doors shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
- B. Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929-11 for a minimum flash ignition temperature of 610°F.
- C. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel and prevents exterior condensation on the panel.
- D. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

- E. Access to unit filters shall be through hinged access door with quarter turn fasteners.
- F. Access to energy recovery wheel, exhaust fan, outside air dampers, and economizer dampers shall be through hinged access door with handle and prop rods. Access to return air filters shall be through removable interlocking sheet metal cover with quarter-turn fasteners on the top and bottom. Access to outside air filters shall be through interlocking sheet metal cover with quarter-turn fastener.
- G. Access to dampers, heating coil and supply fans shall be through hinged service access doors with lockable quarter turn handles.
- H. All access doors shall be flush mounted to cabinetry.
- I. Units with cooling coils shall include double-sloped 304 stainless steel drain pan. Drain pan connection shall be on left hand (right hand) side of the unit with a 1" MPT fitting.
- J. Cooling coils shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.
- K. Unit shall include factory wired control panel compartment LED service lights.

#### 2.4 ELECTRICAL

- A. Unit shall be provided with standard power block for connecting power to the unit.
- B. Unit shall include a factory installed 24V control circuit transformer.
- C. Unit shall include high and low voltage quick connects if shipped in sections.

#### 2.5 SUPPLY FANS

- A. Unit shall include direct drive unhooded, backward curved, plenum supply fans.
- B. Motor shall be a high efficiency electronically commutated motor.
- C. Blower and motor assembly shall be dynamically balanced.
- D. Blower and motor assembly shall utilize neoprene gasket.

#### 2.6 EXHAUST FANS (ENERGY RECOVERY)

- A. Unit shall include direct drive unhooded, backward curved, plenum exhaust fans.
- B. Motor shall be a high efficiency electronically commutated motor.
- C. Blower and motor assembly shall be dynamically balanced.
- D. Blower and motor assembly shall utilize neoprene gasket.
- E. Options:
  - 1. ECM driven supply fan cfm setpoint shall be set with factory installed potentiometer within the control compartment.

2. ECM driven supply fan speed shall be controlled with field provided 0-10 VDC control signal.

## 2.7 COOLING COIL

### A. Evaporator Coil

1. Coil shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and aluminum (stainless steel) end casings. Fin design shall be sine wave rippled.
2. Coil with two circuits shall have interlaced circuitry.
3. Coil shall have (4) (6) rows and 14 fins per inch.
4. Coil shall be hydrogen or helium leak tested.
5. Coil shall be furnished with a factory installed thermostatic expansion valves. The sensing bulbs shall be field installed on the suction line immediately outside the cabinet.
6. Coil shall have left (right) hand external piping connections. Liquid and suction connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

### B. Refrigeration System

1. Air handling unit and matching condensing unit shall be capable of operation as an R-410A split system air conditioner.
2. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.

### C. Options:

1. Modulating hot gas reheat shall be provided on the lead refrigeration circuit. Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, liquid line receiver, electronic controller, supply air temperature sensor and a dehumidification control signal terminal that enables the dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space. Modulating reheat valves and receiver shall be factory installed in the matching AAON condensing unit. Reheat line connections shall be labeled, extend beyond the unit casing and be located near the suction and liquid line connections for ease of field connection. Connections shall be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.
2. Lead (All) (Lag) refrigerant circuit shall be provided with external hot gas bypass to protect against evaporator frosting at low suction pressure and to prevent excessive compressor cycling. Hot gas bypass valves shall be factory installed in the matching AAON condensing unit. Hot gas bypass line connections shall be labeled, extend beyond the unit casing and be located near the suction and liquid line connections for ease of field connection. Connections shall be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.
3. Unit shall be configured as heat pump. Refrigeration circuit shall be equipped with thermal expansion and check valve on the indoor coil.

## 2.8 Filters

- A. Unit shall include 4 inch thick, pleated panel filters with a MERV rating of 13, upstream of the cooling coil. Unit shall also include 2 inch thick, pleated panel pre

filters with an ASHRAE efficiency of 30% and MERV rating of 10, upstream of the 4 inch standard filters.

- B. Unit shall have a filter rack capable of accepting MERV 16 filters.
- C. Unit shall include a clogged filter switch.
- D. Unit shall include factory installed magnehelic gauge measuring the pressure drop across the filter rack.

## 2.9 MIXING BOX SECTION

- A. Unit shall contain a mixing box with return air opening and outside air opening.

## 2.10 ENERGY RECOVERY

- A. Unit shall contain a factory mounted and tested energy recovery wheel. The energy recovery wheel shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings.
- B. Wheel frame shall slide out for service and removal from the cabinet.
- C. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.
- D. Wheels shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.
- E. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.
- F. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
- G. The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.
- H. Energy recovery wheel cassette shall carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date of original

equipment shipment from the factory, whichever is less, shall be covered under the standard limited parts warranty. Certificate.

- I. Unit shall include 2 inch thick, pleated panel outside air filters with an ASHRAE efficiency of 30% and MERV rating of 10, upstream of the wheels.
- J. Hinged service access door shall allow access to the wheel.

## 2.11 CONTROLS

- A. Provide with factory controller, Orion System Manager or approved equal.
- B. General: Touch Screen to provide a direct, graphic-enhanced, menu driven link to allow the end user to view status points, change setpoints, view certain alarms.
  - 1. Provide the following features and functions:
    - a. 4.3" graphical touch screen LCD display.
    - b. Comes equipped with real-time clock backup power supply for short power losses.
    - c. Plastic enclosure; refer to drawings for location of controller.
- C. Adjustable Setpoints:
  - 1. Cooling mode enable.
  - 2. Heating mode enable.
  - 3. Unoccupied cooling offset.
  - 4. Unoccupied heating offset.
  - 5. Push-button override duration.
  - 6. Daylight savings start date.
  - 7. Daylight savings end date.
- D. Status Points:
  - 1. Space temperature.
  - 2. Cooling setpoint.
  - 3. Heating setpoint.
  - 4. Slide adjust.
  - 5. Indoor humidity (return air).
  - 6. Outdoor air temperature.
  - 7. Outdoor air humidity.
  - 8. Outdoor air wetbulb.
  - 9. Outdoor air dewpoint.
  - 10. Supply airflow.
  - 11. Return airflow.
  - 12. Outdoor airflow.
  - 13. Exhaust airflow.
  - 14. CO2.
  - 15. Duct static.
  - 16. Control signal.
  - 17. Building pressure.
  - 18. Cooling status.
  - 19. Cooling stages.
  - 20. Modulating cooling.
  - 21. Economizer status
  - 22. Economizer.

23. Heating status.
  24. Heating stages.
  25. Modulating heating.
  26. Aux heat status.
  27. Emergency heat status.
  28. Main fan.
  29. Fan speed.
- E. Alarms:
1. Sensor failure (any sensor).
  2. Mechanical failure (heating, cooling, etc.).
  3. Out of range temperature.
  4. Refrigeration module alarm.
  5. Dirty filter.
  6. Emergency shutdown.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with ARI 430.
- B. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 1 inch flex between ductwork and fan while running. Refer to Section 23 33 00.
- C. Install assembled units with vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48.
- D. Install floor mounted units on concrete housekeeping pads at least 3-1/2 inches high and 6 inches wider than unit. Refer to Section 03 30 00.
- E. Provide fixed sheaves required for final air balance.
- F. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 00.
- G. Install condensate piping with trap and route from drain pan to nearest floor drain. Refer to Section 23 21 13.

#### 3.2 INSTALLATION - REFRIGERANT COILS

- A. Install sight glass in liquid line within 12 inches of coil. Refer to Section 23 23 00.
- B. Install piping specialties in accordance with Section 23 23 00.

#### 3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

- B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of unit cabinet.
- C. Install new throwaway filters in units at Substantial Completion.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate unit operation and maintenance.
- C. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 238127

VARIABLE REFRIGERANT VOLUME SYSTEMS

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. This Section includes Inverter-based R-410A Mini-Split A. C. & Heat Pump Systems (Indoor Direct Expansion Fan Coil Units and Outdoor Air-cooled Condensing Units) with engineered piping/wiring for Variable Refrigerant Volume/Flow.

1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
  - 1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - 2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
  - 3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
  - 4. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
  - 2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ASTM International:
  - 1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- D. National Electrical Manufacturers Association:
  - 1. NEMA MG 1 - Motors and Generators.
  - 2. National Fire Protection Association:
    - 3. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

#### 1.4 SUBMITTALS

- A. Product Data: For each system, include documentation for rated capacities, operating characteristics, acoustic performance, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Piping Diagrams: Manufacturer to layout and size Refrigerant piping between each component of system. Provide sizing diagrams for review prior to installation by factory-trained refrigerant piping technicians.
- C. Wiring Diagrams: Manufacturer to layout and size power, signal & control wiring between each component of system. Provide sizing diagrams for review prior to installation by factory-trained refrigerant piping technicians/electrical contractor.
- D. Piping Layouts: Provide Floor Plan layout of complete system including but not limited to location of all indoor units, branch boxes, piping, condensing units, etc.
- E. Startup Personnel Certification: Provide evidence of factory training of each Refrigeration Technician scheduled to be utilized in installation/startup/commissioning of variable refrigerant volume mini-split systems.
- F. Operation and Maintenance Data: For Mini-split system to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of mini-split systems and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- D. Performance Ratings: Certify published performance of Mini-split A. C. & Heat Pump units according to ARI Standard 210/240 covering Unitary Heat Pumps.
- E. Electrical Components, Devices, and Accessories: ETL Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Fabricate and install refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."

1.6 QUALITY ASSURANCE

- A. Performance Requirements: Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI 210/240.
- B. Cooling Capacity: Rate in accordance with ARI 210/240.
- C. Sound Rating: Measure in accordance with ARI 270.
- D. Insulation and adhesives: Meet requirements of NFPA 90A.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 VRF SYSTEM – PRE STARUP INSPECTION:

- A. The installing contractor shall provide a copy of the as-built electronic design file used in the installation of the system being inspected. This electronic design file shall have been completed on software approved by the specified VRF manufacture and shall have been updated to reflect as-built conditions.
- B. Prior to start-up, all systems components shall be in a final state of readiness having been fully installed and awaiting start-up. Manufacturer's pre-start up checklist shall be completed and provided to engineer.
- C. The installing contractor shall have prepared the refrigeration piping systems per equipment installation and service manuals. All refrigerant piping systems, upon completion of assembly, shall have been pressurized to a minimum 600 PSI, using dry nitrogen, and held for a consecutive 24HR period. A record of the pressure check process shall be recorded and tagged at the outdoor unit. The tag shall contain information for two events: start & stop. Each event shall include: date, time, fill pressure, outdoor temperature, and the person's full name completing each task.
- D. Upon completion of the 600 PSI pressure check, the system shall be triple evacuated to a level of 500 microns, where it will be held for a period of 1HR with no deflection. The installing contractor shall utilize the triple evacuation method per the equipment install and service manuals. Evacuation start & stop dates, times, and persons involved shall be recorded and tagged at the outdoor equipment. A report shall also be provided to the commissioning agent.

- E. Upon the completion of the 500 micron hold, the calculated additional refrigerant charge can be added. The calculated refrigerant charge shall have been calculated using the manufactures design software. Total refrigerant charge of the system shall be recorded and displayed at the outdoor unit by permanent means.
- F. A review of the equipment settings shall be completed, with recommendations provided to improve system performance, if applicable. Physical changes of system settings will be completed by the contractor.
- G. All pressure check and evacuation tags shall be reviewed by the Mechanical Engineer before physical start-up begins.
- H. Engineer must be notified (1) week before physical system start-up date. Manufacturer's pre start-up checklist must be provided with this notification.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- D. Protect units from weather and construction traffic by storing in dry, roofed location.

#### 1.11 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of condensing units with concrete pad or roof structure.
- C. Coordinate installation of air handling units with building structure.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- E. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- F. Coordinate location of piping and electrical rough-ins.

#### 1.12 VRF EQUIPMENT WARRANTY

- A. Contractor is responsible for successfully completing the Start-Up & Extended Warranty processes and fulfilling all requirements, as outlined by the manufacture. The equipment shall be provided with the following warranty period:
  - 1. Compressor: 10-year
  - 2. Parts: 10-years

- B. Contractor shall submit proof of extended warranty registration within 30 days of equipment startup.

## PART 2 PRODUCTS

### 2.1 DUCTLESS SPLIT COOLING SYSTEM (1 outdoor unit and 1 indoor unit)

- A. Manufacturers:
  - 1. Mitsubishi.
  - 2. Other acceptable manufacturers offering similar products include:
    - a. Daikin.
    - b. Trane.
- B. Provide piping in accessories for a complete and operational system from specification below.

### 2.2 REFRIGERANT MULTI-ZONE HEAT PUMP SYSTEMS ("VRF/VRF" System)

- A. Manufacturers:
  - 1. Mitsubishi.
  - 2. Other acceptable manufacturers offering similar products include:
    - a. Daikin.
    - b. Trane.

### 2.3 GENERAL

- A. The system shall be a variable refrigerant flow (VRF) Heat Pump system for comfort heating and cooling applications. The system shall be capable of providing 100% of nominal heating capacity at 0°F. Heat performance data shall be rated down to -13°F, and a standby temperature no more than -25°F.
- B. The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an authorized training center within the past 2 years. A copy of this certificate shall be presented as part of the VRF equipment submittal process.
- C. Contractor shall employ the services of the VRF manufacturer or representative whose primary job responsibilities are to provide direct technical support of VRF products; sales staff or in-house support staff are not permitted to complete this scope of work, to provide the following:
- D. On-site Project Supervision, providing technical review of installation activities related to the installation of their equipment, system components and controls.
- E. Physical start-up and commissioning of the equipment.
- F. Upon proper equipment start up by the contractor, following the manufactures guidelines and specifications, the VRF manufacture or manufacturer representative shall complete a review of the system performance and complete the following tasks:
- G. Check and confirm all communication addressing of system components.

- H. Check and confirm each indoor unit, individually, is properly piped and wired by commanding the indoor unit on, in either heat or cool mode.
- I. Check and confirm proper BMS integration.
- J. Electronically record a minimum of one-hour of operational data per refrigeration system.
- K. Electronically record dips switch positions on all indoor and outdoor equipment.
- L. VRF manufacture shall provide minimum of [3] onsite visits during the course of the project's completion.
  - 1. Site visit intervals shall be timed as follows:
    - a. 50% project completion
    - b. Equipment startup
    - c. Owner Turnover
- M. Provide the owner's representative a minimum [4]-hour operation and maintenance training class covering systems installed under this scope of work. Training is to be provided one month after owner occupancy.
- N. Upon completion of the Equipment Start-Up, the VRF manufacture or VRF manufacturer representative shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be a close-out letter, manufactures design software as-built file, and all recorded system information.

#### 2.4 REFRIGERANT MULTI-ZONE HEAT PUMP OUTDOOR UNITS

- A. The unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
- B. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.
- C. The unit shall be equipped with multiple circuit boards that interface to the internal controls system and shall perform all functions necessary for operation.
- D. The unit shall be run tested at the factory.
- E. The unit shall have an accumulator with refrigerant level sensors and controls.
- F. The unit shall be capable of operating in heating down to -4°F ambient temperature without additional low ambient controls.
- G. The unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- H. Fan: The unit shall be furnished with one direct drive, variable speed propeller type fan. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed. The fan motor shall be mounted for quiet operation. The fan shall be provided with a raised guard to prevent contact with moving parts. The unit shall have vertical discharge airflow.

- I. Refrigerant: R-410A.
- J. Coil: The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The coil shall be protected with an integral metal guard. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.
- K. Compressor: The compressor shall be a high performance, inverter driven, modulating capacity scroll compressor. A crankcase heater shall be factory mounted on the compressor. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 16% of rated capacity. The compressor will be equipped with an internal thermal overload. The compressor shall be mounted to avoid the transmission of vibration.
- L. Electrical: The outdoor unit shall be controlled by integral microprocessors. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 12VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

## 2.5 CEILING MOUNTED 4-WAY CASSETTE

- A. General: The 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.
- B. Cabinet: The cabinet shall be space-saving ceiling-recessed cassette. The cabinet panel shall have provisions for a field installed filtered outside air intake. Branch ducting shall be allowed from cabinet. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space
- C. Fan: The indoor fan shall be an assembly with one inline-flow fan(s) direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
- D. Filter: Return air shall be filtered by means of an easily removable, washable filter.
- E. Coil: 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. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. Both refrigerant lines to the indoor units shall be insulated.

2.6 VRF SYSTEM – REQUIRED ACCESSORIES:

- A. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow hood & hail guards. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.
- B. 18" four-legged outdoor unit mounting systems shall be provided. 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.
- C. Each outdoor unit module shall be equipped with a basepan heater to protect coil against ice build-up during prolonged winter operation. Basepan heater shall activate only if compressor is operating in heating mode at an outdoor ambient temperature of 39F or below.
- D. Contractor shall provide manufacturer specific maintenance tool to be left on site. The tool shall be capable of displaying all system components; controlling all connected VRF equipment, and displaying status, temperature readings, malfunction logs, and system pressures. The tool shall also be capable of storing and trending this data via connected PC.

2.7 VRF SYSTEM – REQUIRED CONTROLS

- A. A Centralized Controller shall be provided capable of controlling a maximum of two hundred (200) indoor units across multiple outdoor units with the use of three (3) expansion controllers.
- B. The 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.
- C. The Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring.
- D. When being used alone without the expansion controllers, the 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).
- E. This basic set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, dry, setback, and fan), temperature setting, fan speed setting, and airflow direction setting.
- F. The Central Controller shall be able to enable or disable operation of local remote controllers. In terms of scheduling, 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.
- G. The central controller shall come with a BACnet IP integration software license, and be integrated with the town building automation system. This license shall provide read/write control over on/off setup and state, alarm signal and error information, operational mode setup and state, fan speed setup and state, room

temperature and set point, allowable remote controller functions and temperature settings, and system trending.

H. Room Temperature Sensors:

1. Description: Touch screen control temperature sensor with thermistor for room temperature control. Controls group operation for up to 16 indoor units in a single group,

2. User defined functions:
  - a. ON/OFF.
  - b. Operation Mode: AUTO, COOL, HEAT, FAN, DRYING, SETBACK.
  - c. Set temperature.
  - d. Fan speed setting.
  - e. Air flow direction.
3. Wiring: Uses two-wire, stranded, non-polar control wire for connection TB15 connection terminal on the indoor unit.

## 2.8 REFRIGERANT PIPING AND SPECIALTIES PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
  1. Fittings: ASME B16.22 wrought copper.
  2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.
  1. Fittings: ASME B16.26 cast copper.
  2. Joints: Flared.
- C. Pipe Supports and Anchors:
  1. Conform to ASME B31.5, ASTM F708.
  2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
  3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
  7. Vertical Support: Steel riser clamp.
  8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.9 REFRIGERANT

- A. Refrigerant: 410A.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

- B. Install roof-mounting units on equipment supports specified in Division 7.
- C. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."
- D. Connect Power and Controls wiring according to manufacturer's documented instructions and Division 26 specification means and methods.

### 3.3 STARTUP SERVICE

- A. Perform Startup of Inverter-based R-410A Variable Refrigerant Volume/Flow mini-split systems using only manufacturer-trained refrigeration technicians.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Variable Refrigerant Volume/Flow mini-split systems.

END OF SECTION

SECTION 23 82 00

CONVECTION HEATING UNITS

(Part of Filed Sub-Bid Section 230001 – HVAC Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149, Sections 44A to 44J inclusive; and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section Includes:
  - 1. Electric coils.
  - 2. Electric unit heaters.
- B. Related Sections:
  - 1. Section 23 04 00 – General Conditions for Mechanical Trades
  - 2. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connection to units specified by this section.

1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
  - 1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations. Indicate schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers.
- C. Product Data: Submit coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions. Submit mechanical and electrical service locations, capacities and accessories or optional items.
- D. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

## 1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to valves.
- C. Operation and Maintenance Data: Submit manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

## 1.6 QUALITY ASSURANCE

- A. Maintain one copy of each document on site.

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept units on site in factory packing. Inspect for damage. Store under roof.
- C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.

## 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## 1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer's warranty for electric unit heaters.

## PART 2 PRODUCTS

### 2.1 ELECTRIC COILS

- A. Manufacturers:
  - 1. Neptronics
  - 2. Vulcan
  - 3. Indesco
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Assembly: UL listed and labeled, with terminal control box and [hinged] cover, splice box, coil, casing, and controls.

- C. Coil: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
- D. Casing: Die formed channel frame of 16 gage galvanized steel with 3/8 inch mounting holes on 3 inch centers.
- E. Controls: Automatic reset thermal cut-out, built-in magnetic contactors, control circuit transformer and fuse, manual reset thermal cut-out, air flow proving device, non-fused disconnect.

## 2.2 ELECTRIC UNIT HEATERS

- A. Manufacturers:
  - 1. Modine
  - 2. QMark
  - 3. Berko
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Assembly: UL listed and labeled assembly with terminal box and cover, and [built-in] controls.
- C. Heating Elements: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
- D. Cabinet: 0.0478-inch thick steel with easily removed front panel with integral air outlet and inlet grilles.
- E. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- F. Fan: Direct-drive propeller type, statically and dynamically balanced, with fan guard.
- G. Motor: Permanently lubricated, sleeve bearings for horizontal models; ball bearings for vertical models.
- H. Control: Separate fan speed switch and thermostat heat selector switch, factory wired, with switches built-in behind cover. Furnish thermal overload.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. For recessed units, verify recess dimensions are correct size.
- C. Verify wall construction is ready for installation.
- D. Verify concealed blocking and supports are in place and connections are correctly located.

### 3.2 INSTALLATION

- A. Install air coils in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible. Refer to Section 23 31 00.
- B. Support air coil sections independent of piping on steel channel or double angle frames and secure to casings. Furnish frames for maximum three coil sections. Arrange supports to avoid piercing drain pans. Install with airtight seal between coil and duct or casing.
- C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- D. Install coils level.
- E. Make connections to coils with unions and flanges.
- F. Wire electric duct coils. Refer to Section 26 05 03.
- G. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.
- H. Protection: Install finished cabinet units with protective covers during remainder of construction.
- I. Unit Heaters: Hang from building structure. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- J. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Section 26 05 03.

### 3.3 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 26 00 00

ELECTRICAL FILED SUB-BID  
(Filed Sub-bid Required)

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Time, Manner, and Requirements for Submitting Trade-Bids:

1. Trade Contractor 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 shall appear on the upper left hand corner of the envelope.

NAME OF TRADE CONTRACT BIDDER: \_\_\_\_\_  
TRADE CONTRACTOR BID FOR SECTION: \_\_\_\_\_

2. Every Trade Contractor bidder must be certified by the Division of Capital Asset Management for the dollar amount of their bid. Trade bids will be valid only when accompanied by a Certificate of Eligibility and an Update Statement.
3. Sub-bids shall be submitted in accordance with the provisions of Mass General Laws (Ter. Ed.) Chapter 149, Sections 44A-44I, inclusive as amended. The time and place of submission of sub-bids shall be as set forth in the INSTRUCTIONS TO BIDDERS.
4. Each Trade Contractor 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.
5. Trade bids filed with the Awarding Authority shall be accompanied by a BID BOND or CASH or CERTIFIED CHECK or a TREASURER'S or CASHIER'S CHECK issued by a responsible bank or trust company payable to the **Town of Orleans** in the amount of 5 percent of the bid. A Trade Contractor bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Reference Drawings: Refer to the List of Drawings bound in the front of this specification.

D. SUB-SUB-BID REQUIREMENTS

1. Trade sub-bidders' attention is directed to Massachusetts General Laws, Chapter 149a, Section 8 as amended which provides in part as follows:.
2. Each trade 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 trade 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 trade sub-bidder, after trade 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.

CLASS(ES) OF WORK	REFERENCE ARTICLE(S)
Audio-Video Systems	Section 274100 (trade sub-bid part of section 260001)

1.2 FILING OF SUB-BIDS

- A. Include GENERAL CONDITIONS and applicable parts of Division 1 as part of this Section.
- B. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- C. The Work of this section is shown on the following Drawings

ELECTRICAL DRAWINGS

- E000 ELECTRICAL ABBREVIATION AND SYMBOLS
- ES1.00 ELECTRICAL SITE UTILITY PLAN
- ED1.00 ELECTRICAL DEMOLITION PLANS
- EL1.00 ELECTRICAL LIGHTING BASEMENT FLOOR PLAN
- EL1.01 ELECTRICAL LIGHTING FIRST FLOOR PLAN
- EL1.02 ELECTRICAL LIGHTING SECOND FLOOR PLAN
- EP1.00 ELECTRICAL POWER BASEMENT FLOOR PLAN
- EP1.01 ELECTRICAL POWER FIRST FLOOR PLAN
- EP1.02 ELECTRICAL POWER SECOND FLOOR PLAN
- E5.00 ELECTRICAL DETAILS
- E5.01 ELECTRICAL DETAILS
- E6.00 ELECTRICAL SCHEDULES AND DIAGRAMS
- E6.01 ELECTRICAL SCHEDULES AND DIAGRAMS

- D. The following specifications sections shall be part of this file sub-bid section:

- 260001 ELECTRICAL FILED SUB-BID
- 260400 GENERAL CONDITIONS FOR ELECTRICAL TRADES
- 260519 ELECTRICAL POWER CONDUCTORS AND CABLES
- 260526 GROUNDING AND BONDING
- 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- 260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
- 260534 FLOOR BOXES
- 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
- 260923 LIGHTING CONTROL DEVICES
- 262416 PANELBOARDS
- 262726 WIRING DEVICES
- 262819 ENCLOSED SWITCHES
- 265100 LIGHTING
- 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

270533	RACEWAY AND BOXES FOR COMMUNICATIONS SYSTEMS
270553	IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
271000	STRUCTURED CABLING
274100	AUDIO-VIDEO SYSTEMS
283100	FIRE DETECTION AND ALARM

### 1.3 SCOPE OF WORK

- A. The scope of work consists of the installation of all materials to be furnished under Division 26, 27 and 28 and without limiting the generality thereof, consists of furnishing all labor, materials, equipment, plant, transportation, rigging, staging up to roof, appurtenances, and services necessary and/or incidental to properly complete all work as shown on the Electrical, technology, AV, security and fire alarm drawings, as described in the Specifications, or as reasonably inferred from either, in the opinion of the Architect.

### 1.4 SCAFFOLDING AND STAGING

- A. Filed Sub-Bid Contractor shall obtain required permits for, and provide scaffolds, staging and other similar raised platforms required to access and execute the Work of this trade.
1. Scaffolding and staging required for use by Filed Sub-Bid Contractor shall be furnished, erected, maintained in a safe condition, and dismantled when no longer required, by the trade requiring such scaffolding and staging.
  2. Enclose all exterior scaffolding or staging outside of the construction fence with 8 foot height plywood enclosure at the end of each work day to prohibit unauthorized access to the scaffolding or staging.
  3. Portable ladders and mobile platforms of all required heights shall also be provided.

### 1.5 HOISTING MACHINERY, EQUIPMENT, AND SERVICE

- A. Filed Sub-Bid Contractor shall obtain required permits for, and provide all hoisting machinery, rigging devices, crane services, and lift equipment required to access and execute the work of this trade.
1. All hoisting machinery, rigging devices, crane services, and lift equipment shall be furnished, installed, operated, maintained in safe conditions, and dismantled when no longer required, by the trade requiring such equipment or service.

### 1.6 RELATED WORK SPECIFIED ELSEWHERE

- A. The following related work or materials shall be provided under the designated Sections and coordinated by the Contractor:
1. Cutting and Patching including openings in concrete masonry floors, walls and roof:  
General Conditions

### 1.7 SUBMITTALS

- A. Attention is directed to Division 01 Submittals and Section 26 0400 General Conditions for Electrical Trades

## 1.8 RECORD DRAWINGS

- A. Refer to Division 01 Project Record Documents and Section 26 0400 General Conditions for Electrical Trades for the Record Drawing requirements for this section.
- B. ALL DRAWINGS LISTED IN PARAGRAPH 1.2 OF THIS SECTION are required to be maintained as As-Built drawings.
- C. Availability of marked up As Built drawings shall be a prerequisite to scheduling final inspection of this contract and said drawings and original contract documents will be used in checking completion of the work.
- D. Non-availability of marked up As Built drawings or inaccuracies therein may be grounds for cancellation and postponement of any scheduled final inspection by the Architect until the discrepancy has been corrected.

## 1.9 OPERATING AND MAINTENANCE MANUALS

- A. Refer to Section 26 0400 General Conditions for Electrical Trades for the Operating and Maintenance Manual requirements for this Contract.
- B. The Electrical subcontractor shall provide the Contractor five (5) sets of operating and maintenance instructions of all mechanical and electrical equipment furnished and installed under this section.
- C. The Contractor shall collect the operating instructions, bind them into two complete sets and deliver them to the Architect who will check for completeness and deliver them to the Owner.
- D. Delivery of the operating and maintenance manuals shall be a condition precedent to final payment.

## 1.10 INSTRUCTION OF OWNER'S PERSONNEL

- A. Refer to Section 26 0400 General Conditions for Electrical Trades for the Instruction of Owner's Personnel requirements for this Contract..
- B. The Electrical subcontractor shall instruct the Owner's personnel, at the site, in the use and maintenance of equipment installed under this section.
- C. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative shall be a condition precedent to final payment.

## 1.11 GUARANTEE AND SERVICE

- A. Notwithstanding any other requirements of this contract, the Electrical Subcontractor shall guarantee the performance of the installation and equipment included in this Section for one year from the date of Substantial Completion as defined in the General Conditions. Should any defects in materials or workmanship appear during this period, they shall be corrected or

replaced by the Electrical Subcontractor to the satisfaction of the Architect, and at no expense to the Owner.

#### 1.12 PERMITS

- A. The subcontractors attention is directed to the General Conditions. This subcontractor shall be responsible for obtaining and paying for all permits and inspections required to complete all Work described in this section.

#### PART 2 MATERIALS

- 2.1 Refer to specification sections referenced in 1.2 above for specific material requirements for work of this section.

#### PART 3 EXECUTION

- 3.1 Refer to specification sections referenced in 1.2 above for specific execution requirements for work of this section.

END OF SECTION

SECTION 26 04 00

GENERAL CONDITIONS FOR ELECTRICAL TRADES

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section applies to certain sections of Division 08 “Openings”, Division 11 “Equipment”, Division 12 “Furnishings”, Division 21 “Fire Protection”, Division 22 “Plumbing”, Division 23 “Mechanical,” Division 27 “Communications”, Division 28 “Electronic safety and Security”, Division 33 “Utilities” and this section applies to all sections of Division 26, "Electrical" of this project specification unless specified otherwise in the individual sections.
- C. The Drawings of other trades Architectural, Structural, Landscape, Civil, Mechanical, Fire Protection and Plumbing, Communications, and Electronic Safety and Security shall be examined for coordination and familiarity of work with other Contractors. Any duplication or omission of provisions in this project should be brought to the attention of the Owners prior to Bidding.
- D. The drawings of equipment suppliers shall be examined for coordination and familiarity of work with Owner’s equipment suppliers.

1.3 DESCRIPTION

- A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.
- B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division, (Division 27 and Division 28). Where conflicts exist between the drawings and the specifications or between this section of the specifications and other sections, the more stringent or higher cost option shall apply.
- C. It is the intent of this Section of the Specifications to establish a standard of quality and performance characteristics for basic materials and installation methods used in building electrical (communications and electronic safety and security) systems.

#### 1.4 INTENT

- A. This contract is for all labor, materials and equipment required for installation. The system shall be complete and finished in all respects, tested and ready for operation. Work shall include calibration of equipment with factory settings. All materials, equipment and apparatus shall be new and of first class quality.
- B. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.
- C. Minor details not usually shown or specified but necessary for proper installation and operation shall be included in the work as though they were hereinafter shown or specified.
- D. Work under each Section shall include giving written notice to the Owner and Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.
- E. Location of all existing systems and equipment shown on floor plans is based on the best available information. The Contractor shall verify all dimensions and locations of existing systems and equipment in the field and adjust as necessary.
- F. Certain items of existing equipment may be indicated for removal or relocation. Items noted for removal shall be disconnected and turned over to the Owner or disposed of by the Contractor if the Owner so requests. If instructed to dispose of items, the Contractor shall remove the items from the premises and dispose of them in a safe, legal and responsible manner and location. Items noted for relocation are intended for reuse in another location as designated on the Drawings. It shall be the responsibility of the Contractor to remove the material from its present location, store the material in a safe place and reinstall the material in its new location. Questions regarding the suitability of the material or equipment shall be brought to the attention of the Owner and Engineer in writing.
- G. Wherever a particular piece of equipment, device or material is specifically indicated on the Drawings by model number, type, series or other means, that specification shall take precedence over equipment or materials specified herein. For example: If a particular switch is specified on the Drawings, its specification takes precedence over switch specified herein.

#### 1.5 DEFINITIONS

- A. Word "Subcontractor" means specifically the subcontractor working under this Division. Other Contractors are specifically designated "Plumbing Subcontractor", "General Contractor" and so on. Note: Take care to ascertain limits of responsibility for connecting equipment which requires connections by two or more trades.
- B. Word "install" shall mean set in place complete with all mounting facilities and connections as necessary ready for normal use or service.

- C. Words “furnish” or “supply” shall mean purchase, deliver to, and off-load at the job site, all ready to be installed including where appropriate all necessary interim storage and protection.
- D. Word “provide” shall mean furnish (or supply) and install as necessary.
- E. Word “finished” refers to all rooms and areas scheduled to be painted in Room Finish Schedule on the drawings. All rooms and areas not covered in Schedule, including underground tunnels and areas above ceilings shall be considered not finished, unless otherwise noted.
- F. No Exceptions Taken – reviewed and determined to be in general conformance with contract documents.
- G. Words “approved equal” mean any product which in the opinion of the Engineer is equal in quality, arrangement, appearance, and performance to the product specified.
- H. Word “wiring” shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.
- I. Word “product” shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- J. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions."
- K. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- L. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.
- M. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.
- N. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- O. Remove: The term “remove” means “to disconnect from its present position, remove from the premises and to dispose of in a legal manner.”
- P. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- Q. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

## 1.6 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect. (Do not scale the drawings)
- B. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Owner and Engineer shall be notified before proceeding with installations.
- C. The Owner may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.
- D. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, higher rating, or higher value shall be included in the Contract price. The Owner and Engineer shall decide on the item and the manner in which the work shall be installed.

## 1.7 SURVEYS AND MEASUREMENTS

- A. Before submitting his Bid, the Contractors shall visit the site and become thoroughly familiar with all existing conditions under which his work will be installed. This Contract includes all modifications of existing systems required for the installation of new equipment. This Contract includes all necessary offsets, transitions and modifications required to install all new equipment in existing spaces. All new and existing equipment and systems shall be fully operational under this Contract before the job is considered complete. The Contractors shall be held responsible for any assumptions he makes, any omissions or errors he makes as a result of his failure to become fully familiar with the existing conditions at the site and the Contract Documents.
- B. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or which interfere with the intent of the Drawings and Specifications, the Engineer will be notified and work will not proceed until instructions from the Engineer are received.

## 1.8 CODES AND STANDARDS

- A. Reference Standard Compliance
  - 1. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.
  - 2. Independent Testing Organization Certificate: In lieu of the label or listing, indicated above submit a certificate from an independent testing organization, competent to perform testing, and approved by the engineer. The certificate

shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

- B. The Following Codes and Standards for the state and local jurisdiction where the project is located as listed below apply to all electrical work. Wherever Codes and/or Standards are mentioned in these Specifications, the latest applicable edition or revision shall be followed:

Massachusetts State Building Code, with all amendments.  
The International Building Code  
The International Mechanical Code  
The International Plumbing Code  
NFPA 70, the National Electrical Code  
NECA - 1 Standard for Good Workmanship in Electrical Construction  
International Energy Conservation Code

- C. The following Standards shall be used where referenced by the following abbreviations:

AIA	American Institute of Architects
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
EPA	Environmental Protection Agency
FM	Factory Mutual
FSSC	Federal Specification
IEEE	Institute of Electrical and Electronics Engineers
NBS	National Bureau of Standards
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSC	National Safety Council
OSHA	Occupational Safety and Health Administration
UL	Underwriters' Laboratories

- D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.
- E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

#### 1.9 PERMITS AND FEES

- A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, file all necessary Drawings, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspection for his work, and deliver a copy to the Owner and Engineer before request for acceptance and final payment for the work.

#### 1.10 EQUIPMENT EQUIVALENTS AND SUBSTITUTIONS

- A. Certain manufacturers of material, apparatus or appliances are indicated in the drawings and specifications for this project. These items have been used as the basis of design, and as a convenience in fixing the minimum standard of workmanship, finish and design

that is required. If the Contractors uses an “approved equal” alternative to the basis of design, and if the features of that alternative have an impact on other components of the Project, the Contractor shall include the necessary adjustments in those components, whether for architectural, structural, mechanical, electrical, fire protection, or any other elements, plus any adjustments for difference in performance.

- B. Where one name only is used and is followed by the words “or approved equal”, the Contractor must use the item named or he is required to apply for a substitution. Where one name only is used, the Contractor must use that item named.
- C. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for Architect and Engineer review.
- D. Where the Contractor proposes to use an item that is different from the basis of design in the Drawings and specifications, and that will require the redesign of the structure, partitions, foundations, piping, wiring or any other component of the mechanical, electrical, or architectural layout, the Contractor shall provide the necessary redesign of those components.
- E. Where the Contractor proposes to deviate (provide an equivalent or request for substitution) from the basis of design scheduled equipment or materials as hereinafter specified or shown on the drawings, they are required to submit a requested for substitution in writing. The Contractor shall state in their request whether it is a substitution, equivalent or a non approved equivalent to that specified and the amount of credit or extra cost involved. A copy of said request shall be included in the Base Bid with manufacturer’s equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.
- F. If an alternative or substitute item results in a difference in quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such additional equipment required by the system, at no additional cost to the Owner including any costs added to other trades due to the equivalent change from the basis of design detailed in the drawings or included within the specifications.
- G. Equipment, material or devices submitted for review as an “equivalent” shall meet the following requirements:
  - 1. The equivalent shall have the same construction features such as, but not limited to:
    - a. Material thickness, gauge, weight, density, etc.
    - b. Welded, riveted, bolted, etc., construction
    - c. Finish, undercoating, corrosion protection
  - 2. The equivalent shall perform with the same or better operating efficiency.
  - 3. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
  - 4. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as UL or NEMA labels.
- H. Equipment, material or devices submitted for review as a “substitution” shall meet the following requirements:
  - 1. Substitution Request Submittal: Requests for substitution will be considered if received in writing 14 days before the bid date. Requests received later than 14 days before the bid date may be considered or rejected at the discretion of the Engineer/Owner. Once the Contractor submits a complete request for substitution as determined by the engineer, the engineer reserves the right to

request the time necessary to evaluate the request for substitution and review it with the Owner.

2. Submit three (3) copies of each request for substitution for consideration.
3. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
  - a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
  - b. Samples, where applicable or requested.
  - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
  - d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
  - e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
  - f. Cost information, including a proposal of the net change, if any in the Contract Sum.
  - g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
  - h. Engineer's Action: Within one week of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance of a product substitution will be in the form of an Addendum.
  - i. Other Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.
    - 1) The request is directly related to an "or equal" clause or similar language in the Contract Documents.
    - 2) The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
    - 3) A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

## 1.11 SUBMITTAL PROCEDURES

- A. Provide Submittals in accordance with the requirements of Division 1 and as indicated in the following.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
  - 1. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
  - 2. If an intermediate submittal is necessary, process the same as the initial submittal.
  - 3. Allow two weeks for reprocessing each submittal.
  - 4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.
- D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
  - 1. Include the following information on the label for processing and recording action taken.
    - a. Project name.
    - b. Date.
    - c. Name and address of Engineer.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Number and title of appropriate Specification Section.
    - i. Drawing number and detail references, as appropriate.
- E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.
- F. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.

- G. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, to indicate the action taken.

#### 1.12 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
- B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Electrical Contract. Refer to the General Conditions and Supplementary General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.
- C. Provide shop drawings for all devices specified under equipment specifications for all systems including fire alarm, switchgear, clock, lighting, etc., or where called for elsewhere in the Specifications, or where scheduled on the drawings, or where called out on the drawings. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, dimensions, identification of products and materials included, compliance with specified standards, notation of coordination requirements, notation of dimensions established by field measurement and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures) of all shop drawings, performance cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.
- D. Submittals shall be marked with the trade involved, i.e., Electrical, HVAC, Plumbing, Fire Protection, etc. when the submittal could involve more than one trade.
- E. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.
- F. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer.
- G. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.
- H. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or

performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.

- I. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.
- J. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.
- K. Acceptance of shop drawings does not relieve the Contractor from submitting, coordinating and implementing schedules, forms, worksheets and similar as required for owner/operator input and approval as specified herein and required for proper system operation.
- L. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.
- M. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer in writing at least five (5) working days prior to Bidding to allow for issuance of an Addendum.
- N. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

#### 1.13 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 01 Section "PROJECT COORDINATION," to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
  - 1. Indicate the proposed locations of light fixtures, panelboards, conduits, cabinets, etc. Include the following:
  - 2. Clearances for installing and maintaining insulation.
  - 3. Clearances for servicing and maintaining equipment, including NEC requirements and space for equipment disassembly required for periodic maintenance.
  - 4. Equipment connections and support details.
  - 5. Exterior wall and foundation penetrations.
  - 6. Fire-rated wall and floor penetrations.
  - 7. Sizes and locations of required concrete pads and bases.
- B. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
- C. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
- D. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

- E. Electronic copies of the MEP floor plans are available to use as a basis for preparing coordination drawings and can be provided by the Engineer. If the Contractor elects to obtain the Engineers electronic files an Electronic File Release Form must be submitted. This form must be signed by the Contractor, Owner, and Architect. Upon receipt of a signed copy of the Electronic File Release Form, the Engineer will provide copies of the electronic files for the Contractor's use. A copy of the Electronic File Release Form is appended to the end of this specification section

#### 1.14 COORDINATION WITH OTHER DIVISIONS

- A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.
- B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, heating, condenser, chilled water piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.
- C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.
- D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.
- E. Where work is installed prior to preparation and approval of the Coordination Drawings or in conflict with the approved Coordination drawings and if so directed in other Sections, the Contractor indicated shall prepare composite working drawings and sections clearly showing how the work is to be installed in relation to the work of other trades, at no extra charge to the Owner.

#### 1.15 WORKMANSHIP

- A. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.
- C. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, journeymen, electricians, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

- D. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.
- E. All labor for installation of electrical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

#### 1.16 SHUTDOWNS

- A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner.
- B. The Engineer and the Owner shall be notified in writing of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.
- C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

#### 1.17 TEMPORARY UTILITIES

- A. General: Provide new materials and equipment; if acceptable to the Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
- C. First Aid Supplies: Comply with governing regulations.
- D. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.
- E. Provide temporary lighting in all areas, throughout construction activities.
  - 1. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Engineer, and will not be accepted as a basis of claims for a Change Order.
  - 2. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.

- a. Except where overhead service must be used, install electric power service underground.
  - b. Power Distribution System: Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.
3. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period.
- F. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.
- G. Termination and Removal: Unless the Engineer requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

#### 1.18 PROJECT PHASING

- A. Work under each Section shall include all necessary temporary connections, equipment, conduit, wiring, fire alarm equipment and testing, lighting and emergency lighting, fire stopping, connection of necessary mechanical equipment, labor, and material as necessary to accommodate the phasing of Construction as developed by the General Contractor or Construction Manager and approved by the Owner. All existing systems that pass-thru an area of the building or are required to be maintained in a phased fashion during construction shall remain operational during all phases of construction. No extra compensation shall be granted the Contractor for work required to maintain existing systems operational or to accommodate the construction phasing of the project.

#### 1.19 PROTECTION OF MATERIALS AND EQUIPMENT

- A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.
- B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.
- C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

#### 1.20 ADJUSTING AND TESTING

- A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.
- B. Where requested by the Engineer or specified in the contract documents, a factory-trained service representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment. The service representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer. Factory start-up reports shall be included in the operation and maintenance manuals under the appropriate equipment section.

#### 1.21 CLEANING

- A. The Contractor shall thoroughly clean all equipment of all foreign substances, oils, dust, dirt, etc., inside and out before final acceptance by the Engineer.
- B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.
- C. During the course of construction, all conduits shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.
- D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work.
- E. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
  - 1. Remove labels that are not permanent labels.
  - 2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
  - 3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces and panelboard interiors.
  - 4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean light fixtures and lamps.
- F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into

drainage systems. Remove and dispose of ALL waste materials, packaging material, skids etc. from the site and dispose of in a lawful manner in accordance with municipal, state and federal regulations.

- G. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

#### 1.22 OPERATING AND MAINTENANCE

- A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least seven (7) day notice to the Owner and the Engineer in advance of this period.
- B. The Contractor shall include the maintenance schedule for the principal items of equipment furnished under this Division.
- C. The Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.
- D. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. At a minimum, the following equipment will require this inspection: emergency generator, fire alarm system, nurse call system, paging systems, etc. These letters will be bound into the operating and maintenance books.
- E. Refer to individual trade Sections for any other particular requirements related to operating instructions.
- F. Demonstration shall be recorded on CD Rom with two (2) discs turned over to the Owner.

#### 1.23 OPERATING AND MAINTENANCE MANUALS

- A. Prepare operating and maintenance manuals in accordance with the requirements of Division 1 and as follows. The Contractor shall prepare six (6) copies of a complete maintenance and operating instructions manual, bound in booklet form. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty, 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder.
- B. Manual shall 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 replacement parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - 4. Servicing instructions and lubrication charts and schedules.

5. Emergency instructions.
  6. Spare parts list.
  7. Copies of warranties.
  8. Wiring diagrams.
  9. Recommended "turn around" cycles.
  10. Inspection procedures.
  11. Shop Drawings and Product Data.
  12. Equipment start-up reports.
- C. Include in the manual, a tabulated equipment schedule for all equipment. Schedule shall include pertinent data such as: make, model number, serial number, voltage, normal operating current, belt size, filter quantities and sizes, bearing number, etc. Schedule shall include maintenance to be done and frequency.
- D. Maintenance and instruction manuals shall be submitted to the Owner at the same time as the seven (7) day notice is given prior to the instruction period.

#### 1.24 ACCEPTANCES

- A. The equipment, materials, workmanship, design and arrangement of all work installed under the Electrical Sections shall be subject to the review of the Engineer.
- B. Within 30 days after the awarding of a Contract, the Electrical Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Electrical Sections. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.
- C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Owner and Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.
- D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Electrical Contractor shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.
- E. If material or equipment is installed before it is reviewed and/or approved, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.
- F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

#### 1.25 RECORD DRAWINGS

- A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.

- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
  2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
  3. Note related Change Order numbers where applicable.
  4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
  5. Final record documents shall be prepared in the latest AutoCad version and digital media for all drawings and a clean set of reproducible paper copies shall be turned over to the Owner at the completion of the work.

#### 1.26 WARRANTIES AND BONDS

- A. The following general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties are to be included:
1. General close-out requirements included in Section "Project Close-out."
  2. Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of the specifications.
  3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

#### 1.27 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.
- H. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.
- I. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.
  - 1. Refer to individual Sections of Divisions 2 through [16][50] for specific content requirements, and particular requirements for submittal of special warranties.
- J. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- K. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
  - 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
  - 2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.
  - 3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

#### 1.28 GUARANTEES

- A. The Contractor shall guarantee all material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner.

During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by this Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineers satisfaction.

- B. Contractor shall provide name, address, and phone number of all contractors and subcontractors and associated equipment they provided

#### 1.29 PROJECT CLOSE-OUT

- A. Contractor shall submit annual maintenance proposal to the Architect/Engineer for review and approval as part of the close out documents.
- B. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
- C. Deliver tools, spare parts, extra stock, and similar items.
- D. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
- E. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
- F. Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
  - 1. The Engineer will repeat inspection when requested and assured that the Work has been substantially completed.
  - 2. Results of the completed inspection will form the basis of requirements for final acceptance.

END OF SECTION

**Electronic File Release Form**

DELIVERY OF ELECTRONIC FILES FOR: \_\_\_\_\_  
Project Name

In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by the Design Professional, the Client covenants and agrees that all such drawings and data are instruments of service of the Design Professional, who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

The Client further agrees not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Client agrees to waive all claims against the Design Professional resulting in any way from any unauthorized changes or reuse of the drawings and data for any other project by anyone other than the Design Professional.

In addition, the Client agrees, to the fullest extent permitted by law, to indemnify and hold the Design Professional harmless from any damage, liability or cost, including reasonable attorneys' fees and costs of defense, arising from any changes made by anyone other than the Design Professional or from any reuse of the drawings and data without the prior written consent of the Design Professional.

Under no circumstances shall transfer of the drawings and other instruments of service on electronic media for use by the Client be deemed a sale by the Design Professional, and the Design Professional makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.

\_\_\_\_\_  
Client's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company - Title

\_\_\_\_\_  
Architects' Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Firm - Title

\_\_\_\_\_  
Owner's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Company - Title

## SECTION 260519

### ELECTRICAL POWER CONDUCTORS AND CABLES

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

#### PART 1 GENERAL

##### 1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

##### 1.2 SECTION INCLUDES

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Wire pulling lubricant.
- G. Cable ties.

##### 1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Division 07 – Thermal and Moisture Protection.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 28 3100 - Fire Detection and Alarm: Fire alarm system conductors and cables.

##### 1.4 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.

- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- E. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.
- F. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; Revision A, 2008.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
- I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- P. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- Q. UL 719 – Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.
- R. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

## 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
  - 3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
  - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

## 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
- D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

## 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

## 1.9 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

## PART 2 PRODUCTS

### 2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted, unless noted otherwise.
- D. Service entrance cable is not permitted, unless noted otherwise.
- E. Armored cable is not permitted.
- F. Metal-clad cable is permitted as follows:
  - 1. Where not otherwise restricted, may be used:
    - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      - 1) Maximum Length: 6 feet.
    - b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
      - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
  - 2. In addition to other applicable restrictions, may not be used:
    - a. Feeders to panelboards.
    - b. Homeruns from first device, such as lighting fixture, MEP equipment, wiring device to panelboards.
    - c. Where not approved for use by the authority having jurisdiction.
    - d. Where exposed to view.
    - e. Where exposed to damage.
    - f. For damp, wet, or corrosive locations.

### 2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide conductors and cables with lead content less than 300 parts per million.
- D. Provide new conductors and cables manufactured not more than one year prior to installation.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- F. Comply with NEMA WC 70.
- G. Comply with FS A-A-59544 where applicable.
- H. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

- I. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- J. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- K. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
- L. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
- M. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- N. Conductor Material:
  - 1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, or ASTM B8 unless otherwise indicated.
- O. Minimum Conductor Size:
  - 1. Branch Circuits: 12 AWG.
    - a. Exceptions:
      - 1) 20 A, 120 V circuits longer than 75 feet 10 AWG minimum, and sized for voltage drop.
      - 2) 20 A, 120 V circuits longer than 150 feet 8 AWG minimum, and sized for voltage drop.
      - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG minimum, and sized for voltage drop.
  - 2. Control Circuits: 14 AWG.
- P. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- Q. Conductor Color Coding:
  - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
  - 2. Color Coding Method: Integrally colored insulation.
    - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
  - 3. Color Code:
    - a. 240/120 V, 1 Phase, 3 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Neutral/Grounded: White.
    - b. Equipment Ground, All Systems: Green.
    - c. Travelers for 3-Way and 4-Way Switching: Pink.
    - d. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
    - e. For control circuits, comply with manufacturer's recommended color code.

## 2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
  - 1. Copper Building Wire:
    - a. Cerro Wire LLC.
    - b. Southwire Company
    - c. General Cable Technologies
    - d. Substitutions: See Section 01 - Product Requirements.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
  - 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
    - a. Installed Underground: Type XHHW-2.

## 2.4 METAL-CLAD CABLE

- A. Manufacturers:
  - 1. AFC Cable Systems Inc.
  - 2. Encore Wire Corporation
  - 3. Southwire Company
  - 4. General Cable Technologies
  - 5. Substitutions: See Section 01 - Product Requirements.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide oversized neutral conductors where indicated or required.
- G. Provide dedicated neutral conductor for each phase conductor where indicated or required.
- H. Grounding: Full-size integral equipment grounding conductor.
  - 1. Provide additional isolated/insulated grounding conductor where indicated or required.
- I. Armor: Steel, interlocked tape.

- J. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

## 2.5 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps:
  - 1. Copper conductors 10 AWG and smaller: Install insulated spring wire connectors with plastic caps
  - 2. Copper Conductors Size 8 AWG: Install solderless pressure connectors with insulating covers
  - 3. Copper Conductors Size 6 AWG and larger: Install pressure connectors or split bolt connectors.
- D. Wiring Connectors for Terminations:
  - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
  - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
  - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
  - 6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
  - 7. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
  - 1. Manufacturers:
    - a. 3M
    - b. Ideal Industries, Inc.
    - c. NSI Industries LLC.
    - d. IlSCO
    - e. Erico
    - f. Substitutions: See Division 01 – General Requirements.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
  - 1. Manufacturers:
    - a. Burndy LLC.

- b. IlSCO
  - c. Thomas & Betts Corporation
  - d. Substitutions: See Division 01 – General Requirements.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- 1. Manufacturers:
    - a. Burndy LLC.
    - b. IlSCO
    - c. Thomas & Betts Corporation
    - d. Erico
    - e. Substitutions: See Division 01 – General Requirements.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
- 1. Manufacturers:
    - a. Burndy LLC.
    - b. IlSCO
    - c. Thomas & Betts Corporation
    - d. Substitutions: See Division 01 – General Requirements.

## 2.6 WIRING ACCESSORIES

- A. Electrical Tape:
- 1. Manufacturers:
    - a. 3M
    - b. Plymouth Rubber Europa
    - c. Substitutions: See Division 01 – General Requirements.
  - 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F .
  - 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
  - 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- 1. Manufacturers:
    - a. 3M
    - b. Burndy LLC.
    - c. Thomas & Betts Corporation
    - d. Substitutions: See Division 01 – General Requirements.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- 1. Manufacturers:
    - a. 3M
    - b. American Polywater Corporation
    - c. Ideal Industries, Inc.
    - d. Substitutions: See Division 01 – General Requirements.

- D. Cable Ties: Material and tensile strength rating suitable for application.
  - 1. Manufacturers:
    - a. Burndy LLC.
    - b. Substitutions: See Section 01 - Product Requirements.
  - 2. Provide plenum rated cable ties.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as shown on the drawings.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

### 3.3 INSTALLATION

- A. Feeders and branch circuits shall be concealed in walls or ceilings, except in electrical rooms and other similar utility spaces.
- B. Circuiting Requirements:
  - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
  - 2. When circuit destination is indicated and routing is not shown, determine exact routing required.
  - 3. Arrange circuiting to minimize splices.
  - 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  - 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  - 6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted where indicated:
    - a. Dedicated neutral conductors are considered current-carrying conductors.
    - b. Increase size of conductors as required accounting for ampacity derating.
    - c. Size raceways, boxes, etc. to accommodate conductors.
  - 7. Common Neutrals: Not allowed.
- C. Install products in accordance with manufacturer's instructions.
- D. Perform work in accordance with NECA 1 (general workmanship).

- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
  - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  - 2. Pull all conductors and cables together into raceway at same time.
  - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
  - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
  - 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- I. Terminate cables using suitable fittings.
  - 1. Metal-Clad Cable (Type MC):
    - a. Use listed fittings.
    - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
    - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
    - d. Secure at maximum interval of 5 ft.
    - e. Install parallel and perpendicular to building lines.
    - f. Bundle cables in common routes back to panelboards.
    - g. Secure from structure using suitable J-hooks or plenum rated cable ties.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- N. Make wiring connections using specified wiring connectors.
  - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
  - 2. Do not remove conductor strands to facilitate insertion into connector.
  - 3. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.

4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
    - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
    - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
  2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
    - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
    - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
  3. Wet Locations: Use heat shrink tubing.
- P. Insulate ends of spare conductors using vinyl insulating electrical tape.
- Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- R. Identify conductors and cables in accordance with Section 26 0553.
- S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07.
- T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

### 3.4 FIELD QUALITY CONTROL

- A. See Division 01 – General Requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
  1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Division 03– Concrete.
- C. Division 09 - Finishes.
- D. Section 26 0400 – General Conditions for Electrical Trades
- E. Section 26 0519 - Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 5100 - Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 780 - Standard for the Installation of Lightning Protection Systems.
- G. UL 467 - Grounding and Bonding Equipment.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify exact locations of underground metal water service pipe entrances to building.
  - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
- B. Sequencing:
  - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

#### 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
  - 1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field quality control test reports.
- F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

#### 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
  - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
  - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
  - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System:
  - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    - a. Provide continuous grounding electrode conductors without splice or joint.
    - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
  - 2. Metal Underground Water Pipe(s):
    - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
    - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
    - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Other Metal Piping:
    - a. Provide connection to all metallic gas piping and miscellaneous metal piping of continuous lengths.
    - b. Bond in accordance with NFPA 70.
    - c. Size bonding conductor in accordance with NFPA 70.
  4. Metal In-Ground Support Structure:
    - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
  5. Concrete-Encased Electrode:
    - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
  6. Ground Rod Electrode(s):
    - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
    - b. Space electrodes not less than 22 feet from each other and any other ground electrode.
    - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
    - d. Provide ground enhancement material around electrode where indicated.
    - e. Provide ground access well for each electrode.
  7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
  8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
    - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
    - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
    - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- G. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
  2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
  6. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    - b. Metal gas piping.

- c. Metal process piping.
- 7. Provide bonding for metal building frame.
- 8. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
  
- H. Communications Systems Grounding and Bonding:
  - 1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
  - 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
    - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
    - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
    - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
    - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

## 2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
  - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 2. Provide products listed and labeled as complying with UL 467 where applicable.
  
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0519:
  - 1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:
      - 1) Use bare copper conductors where installed underground in direct contact with earth.
      - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
  - 2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.
  
- C. Connectors for Grounding and Bonding:
  - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
  - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
    - a. Exceptions:
      - 1) Use mechanical connectors for connections to electrodes at ground access wells.
  - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
    - a. Exceptions:
      - 1) Use exothermic welded connections for connections to metal building frame.
  - 4. Manufacturers - Mechanical and Compression Connectors:
    - a. Advanced Lightning Technology (ALT)
    - b. Burndy LLC.
    - c. Harger Lightning & Grounding
    - d. Thomas & Betts Corporation
    - e. Substitutions: See Division 01 - General Requirements.

5. Manufacturers - Exothermic Welded Connections:
  - a. Burndy LLC.
  - b. Cadweld, a brand of Erico International Corporation
  - c. ThermOweld, a brand of Continental Industries, Inc. Substitutions: See Division 01 - General Requirements.
  
- D. Ground Bars:
  1. Description: Copper rectangular ground bars with mounting brackets and insulators.
  2. Size: As indicated.
  3. Holes for Connections: As indicated or as required for connections to be made.
  4. Manufacturers:
    - a. Advanced Lightning Technology (ALT)
    - b. Erico International Corporation
    - c. Harger Lightning & Grounding
    - d. ThermOweld, a brand of Continental Industries, Inc.
    - e. Substitutions: See Division 01 - General Requirements.
  
- E. Ground Rod Electrodes:
  1. Comply with NEMA GR 1.
  2. Material: Copper-bonded (copper-clad) steel.
  3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
  4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
  5. Manufacturers:
    - a. Advanced Lightning Technology (ALT)
    - b. Erico International Corporation
    - c. Galvan Industries, Inc.
    - d. Harger Lightning & Grounding
    - e. Substitutions: See Division 01 - General Requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as shown on the drawings.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 PREPARATION

- A. Remove paint, rust, mill oils, surface contaminants at connection points.

### 3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree

angle or bury horizontally in trench at least 30 inches deep in accordance with NFPA 70 or provide ground plates.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
  2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Install in accordance with IEEE 142.
- F. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
- G. Install grounding and bonding conductors concealed from view.
- H. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- I. Install continuous grounding using underground cold water system, driven rods and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- J. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- K. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- L. Permanently attach equipment and grounding conductors prior to energizing equipment.
- M. Identify grounding and bonding system components in accordance with Section 26 0553.

### 3.4 FIELD QUALITY CONTROL

- A. See Division 01 - General Requirements.

- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

## SECTION 260529

### HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

#### PART 1 GENERAL

##### 1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

##### 1.2 SECTION INCLUDES

- A. Support and attachment components for electrical equipment, conduit, cable, boxes, and other electrical work.

##### 1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Division 03 - Cast-in-Place Concrete: Concrete equipment pads.
- C. Section 260400 – General Conditions for Electrical Trades
- D. Section 260533 – Raceway and Boxes for Electrical Systems: Additional support and attachment requirements for conduits.
- E. Section 265100 - Lighting: Additional support and attachment requirements for interior luminaires.

##### 1.4 REFERENCE STANDARDS

- A. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. See Division 01: General Requirements.
- B. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components being installed.
  - 2. Coordinate the work with other trades and provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- C. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.

#### 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Installer's Qualifications: Include evidence of compliance with specified requirements.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### 1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with latest adopted version of applicable building code, including any addendum or supplements.

- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding: As specified in Section 260400 General Requirements for Electrical Trades.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
  1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
  2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, fiberglass or approved equivalent unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
  1. Conduit Straps: One-hole or two-hole type; zinc plated steel.
  2. Conduit Clamps: Bolted type unless otherwise indicated.
  3. Manufacturers:
    - a. Cooper Crouse-Hinds, a division of Eaton Corporation
    - b. Erico International Corporation

- c. O-Z/Gedney, a brand of Emerson Industrial Automation
  - d. Thomas & Betts Corporation
  - e. Substitutions: See Division 01 - General Requirements.
  
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
  - 1. Manufacturers:
    - a. Cooper Crouse-Hinds, a division of Eaton Corporation
    - b. Erico International Corporation
    - c. O-Z/Gedney, a brand of Emerson IndustrialAutomation
    - d. Thomas & Betts Corporation
    - e. Substitutions: See Division 01 - General Requirements.
  
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  - 1. Comply with MFMA-4.
  - 2. Channel Material:
    - a. Indoor Dry Locations: Use galvanized steel.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
  - 3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
  - 4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
  - 5. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation
    - b. Thomas & Betts Corporation
    - c. Unistrut, a brand of Atkore International Inc.
    - d. Substitutions: See Division 01- General Requirements.
    - e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
  - 1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2 inch diameter.
    - b. Busway Supports: 1/2 inch diameter.
    - c. Single Conduit up to 1 inch trade size: 1/4 inch diameter.
    - d. Single Conduit larger than 1 inch trade size: 3/8 inch diameter.
    - e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
    - f. Outlet Boxes: 1/4 inch diameter.
    - g. Luminaires: 1/4 inch diameter.
  
- F. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
  - 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  - 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  - 3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
  - 4. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation

- b. Erico International Corporation
- c. PHP Systems/Design
- d. Unistrut, a brand of Atkore International Inc.
- e. Substitutions: See Division 01 - General Requirements.

G. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners may be used with:
  - a. Permission by Architect.
  - b. Permission by Structural Engineer.
  - c. Use only threaded studs; do not use pins.
11. Hammer-driven anchors and fasteners are permitted as follows:
  - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
  - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
  - a. Comply with MFMA-4.
  - b. Channel Material: Use galvanized steel.
  - c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
  - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Manufacturers - Mechanical Anchors:
  - a. Hilti, Inc.
  - b. ITW Red Head, a division of Illinois Tool Works, Inc.
  - c. Powers Fasteners, Inc.
  - d. Simpson Strong-Tie Company Inc.
  - e. Substitutions: See Division 01 - General Requirements.
14. Manufacturers - Powder-Actuated Fastening Systems:
  - a. Hilti, Inc.
  - b. ITW Ramset, a division of Illinois Tool Works, Inc. Powers Fasteners, Inc.
  - c. Simpson Strong-Tie Company Inc.
  - d. Substitutions: See Division 01 - General Requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Install conduit and raceway support and spacing in accordance with NEC.
- H. Install multiple conduit runs on common hangers.
- I. Anchors and Fasteners:
  - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors.
  - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners.
  - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
  - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
  - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
  - 6. Sheet Metal: Provide sheet metal screws.
  - 7. Wood Elements: Provide wood screws.
- J. Inserts:
  - 1. Install inserts for placement in concrete forms.
  - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.
- K. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
  2. Install surface mounted cabinets and panelboards with minimum of four anchors.
  3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
  4. Support vertical conduit at every floor.
- L. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Division 03.
  5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- M. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- N. Secure fasteners according to manufacturer's recommended torque settings.
- O. Remove temporary supports.

### 3.3 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section Includes:
1. Conduit Applications
  2. General Requirements
  3. Galvanized steel rigid metal conduit (RMC).
  4. Intermediate metal conduit (IMC)
  5. Flexible metal conduit (FMC).
  6. Liquidtight flexible metal conduit (LFMC).
  7. Electrical metallic tubing (EMT).
  8. Rigid polyvinyl chloride (PVC) conduit.
  9. Liquidtight flexible nonmetallic conduit (LFNC).
  10. Non-metallic tubing
  11. Wireway
  12. Boxes
  13. Accessories.
- B. Related Sections:
1. Section 260503 - Equipment Wiring Connections.
  2. Section 260519 – Electrical Power Conductors and Cables.
  3. Section 260526 - Grounding and Bonding for Electrical Systems.
  4. Section 260529 - Hangers and Supports for Electrical Systems.
  5. Section 260534 - Floor Boxes for Electrical Systems.
  6. Section 260553 - Identification for Electrical Systems.
  7. Section 262726 - Wiring Devices.
  8. Section 270533 - Raceway and Boxes for Communications Systems.
  9. Section 280533 - Raceway and Boxes for Electronic Safety and Security.

1.3 REFERENCES

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC);
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S);

- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A);
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction;
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT);
- F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit;
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC);
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable;
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit;
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing;
- K. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT);
- L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- M. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- N. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- Q. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- R. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- S. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- T. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- U. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- V. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.
- W. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.
- X. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

- Y. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

#### 1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.
- B. Branch circuits shall be concealed in walls and above ceilings unless otherwise indicated on drawings. Do not route branch circuits in or under slab unless otherwise indicated. This shall also apply to homeruns back to panelboards. Adhere to the requirements within Part 2 of this Section for additional requirements.
- C. Feeders shall be concealed in walls and above ceilings unless otherwise indicated on drawings. Do not route feeder circuits in or under slab unless otherwise indicated. Adhere to the requirements within Part 2 of this Section for additional requirements.
- D. Electrical feeders shall be run above ceilings in conduit. Branch circuits shall be run above ceilings in conduit from panelboard to first device. After first device, branch circuits may be run with MC cable in concealed spaces as outlined in the specifications. Installation of feeders or branch circuits in or under concrete slab is not acceptable.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
  - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
  - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

#### 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for all conduits and fittings outlined in Part 2.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

- D. Shop Drawings:
  - 1. Indicate proposed arrangement for conduits to be installed within or under structural concrete slabs, where permitted.
  - 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- E. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs (where permitted), and conduits 2 inch trade size and larger.
- F. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- G. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. See Division 01 – General Requirements
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.
- D. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

#### 1.9 COORDINATION

- A. See Division 01 – General Requirements
- B. Coordinate installation of outlet boxes for equipment connected under Section 260503.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

- D. Electrical contractor is responsible to fully coordinate with the site and concrete contractors and all other trades when routing conduit underslab. Routing of conduit underslab may be acceptable, provided spacing of conduits is adequate for proper backfilling of area surrounding conduits. Adequate spacing shall mean using factory made conduit spacers that allow for a minimum of 3-inches for backfilling with sand or 3 times the pipe diameter for backfilling with a structural fill. Proposed conduit routing, installation and methods and backfilling procedures shall be submitted to the Engineer for review prior to installation.

## PART 2 PRODUCTS

### 2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- C. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications listed below. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
1. Underground:
    - a. Under Slab on Grade: Use schedule 40 rigid PVC conduit with galvanized steel rigid metal conduit sweeps. Provide cast metal boxes or nonmetallic handhole. Applications limited to:
      - 1) Panelboard feeders
      - 2) Floor boxes
      - 3) Free-standing equipment
    - b. Exterior, Within Trench: Use schedule 40 or schedule 80 rigid PVC conduit with galvanized steel rigid metal conduit sweeps. Provide cast metal boxes or nonmetallic handhole.
    - c. Exterior, Concrete Encased: Use Type EB rigid PVC conduit. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
  2. Embedded Within Concrete:
    - a. Within Slab on Grade: Floor box applications only.
    - b. Within Slab Above Ground: Not permitted.
    - c. Within Concrete Walls Above Ground: Use Type EB rigid PVC conduit. Provide flush mounted box rated for masonry applications.
  3. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT). Provide flush mounted boxes rated for masonry applications.
  4. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT) or MC cable (where allowed). Provide flush mounted sheet-metal boxes.
  5. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT) or MC cable (where allowed).
  6. Interior, Damp or Wet Locations Provide:

- a. Rigid steel conduit
  - b. Intermediate metal conduit
  - c. Electrical metallic tubing (EMT) with compression fittings
  - d. Schedule 40 PVC conduit
  - e. Provide cast metal or nonmetallic outlet, junction, and pull boxes.  
Provide flush mounting outlet box in finished areas.
7. Exposed, Interior dry locations: Use electrical metallic tubing (EMT)
  8. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
  9. Exposed, Exterior: Use galvanized steel rigid metal conduit
  10. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
    - a. Maximum Length: 6 feet.
  11. Connections to Vibrating Equipment:
    - a. Dry Locations: Use flexible metal conduit or MC Cable.
    - b. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
    - c. Maximum Length: 6 feet unless otherwise indicated.
    - d. Vibrating equipment includes, but is not limited to:
      - 1) Motors.
      - 2) Pumps.
      - 3) Fans.

## 2.2 GENERAL REQUIREMENTS

- A. Fittings for Grounding and Bonding: Also comply with Section 260526.
- B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
  1. Branch Circuits: 3/4 inch trade size.
  2. Branch Circuit Homeruns: 3/4 inch trade size.
  3. Control Circuits: 1/2 inch trade size.
  4. Flexible Connections to Luminaires: 3/4 inch trade size.
  5. Underground, Interior: 1 inch trade size.
  6. Underground, Exterior: 1 inch trade size.

## 2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  1. Allied Tube and Conduit.
  2. Western Tube and Conduit.
  3. Wheatland Tube Company.
  4. Substitutions: See Division 01 – General Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc.
    - b. O-Z/Gedney.
    - c. Thomas & Betts Corporation.
    - d. Substitutions: See Division 01 – General Requirements
  - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
  - 4. Material: Use steel or malleable iron.
  - 5. Do not use die cast zinc fittings.
  - 6. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

#### 2.4 INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
  - 1. Allied Tube and Conduit.
  - 2. Western Tube and Conduit.
  - 3. Wheatland Tube Company.
  - 4. Substitutions: See Division 01 – General Requirements.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Industrial Automation
    - c. Thomas & Betts Corporation
    - d. Substitutions: See Division 01 – General Requirements
  - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel.
    - a. Do not use die cast zinc fittings.
  - 4. Connectors and Couplings: Use threaded type or compression fittings only.

#### 2.5 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
  - 1. Carlon Electrical Products.
  - 2. Allied Tube and Conduit.
  - 3. AFC Cable Systems, Inc
  - 4. Substitutions: See Division 01 – General Requirements.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:

1. Manufacturers:
  - a. Bridgeport Fittings Inc
  - b. O-Z/Gedney, a brand of Emerson Industrial Automation
  - c. Thomas & Betts Corporation
  - d. Substitutions: See Division 01 – General Requirements
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel.
  - a. Do not use die cast zinc fittings.

## 2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
  1. Carlon Electrical Products.
  2. Allied Tube and Conduit.
  3. AFC Cable Systems, Inc
  4. Substitutions: See Division 01 – General Requirements
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
  1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Industrial Automation
    - c. Thomas & Betts Corporation
    - d. Substitutions: See Division 01 – General Requirements.
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel
    - a. Do not use die cast zinc fittings.

## 2.7 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
  1. Allied Tube and Conduit.
  2. Western Tube and Conduit.
  3. Wheatland Tube Company.
  4. Substitutions: See Division 01 – General Requirements
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
  1. Manufacturers:
    - a. Bridgeport Fittings Inc
    - b. O-Z/Gedney, a brand of Emerson Industrial Automation
    - c. Thomas & Betts Corporation
    - d. Substitutions: See Division 01 – General Requirements
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel.
4. Connectors and Couplings: Use compression (damp or wet location) or set-screw type elsewhere

## 2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
  1. Cantex Inc
  2. Carlon, a brand of Thomas & Betts Corporation
  3. JM Eagle
  4. Substitutions: See Division 01 – General Requirements
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

## 2.9 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

- A. Manufacturers:
  1. AFC Cable Systems, Inc
  2. Electri-Flex Company
  3. International Metal Hose
  4. Substitutions: See Division 01 – General Requirements
- B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
- C. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

## 2.10 WIREWAY

- A. Manufacturers:
  1. Carlon Electrical Products.
  2. Thomas & Betts Corp.
  3. Hoffman.
  4. Substitutions: See Division 01 – General Requirements
- B. Product Description: General purpose wireway.
- C. Knockouts: Manufacturer's standard.
- D. Cover: Hinged cover with full gaskets.

- E. Connector: Slip-in.
- F. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

## 2.11 BOXES

- A. General Requirements:
  - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
  - 1. Manufacturers:
    - a. Cooper Crouse-Hinds, a division of Eaton Corporation
    - b. Hubbell Incorporated; Bell Products
    - c. Hubbell Incorporated; RACO Products
    - d. Leviton
    - e. O-Z/Gedney, a brand of Emerson Industrial Automation
    - f. Thomas & Betts Corporation
    - g. Substitutions: See Division 01 – General Requirements
  - 2. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  - 3. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  - 4. Use cast iron boxes or cast aluminum boxes with threaded hubs where exposed galvanized steel rigid metal conduit is used.
  - 5. Use cast aluminum boxes with threaded hubs where aluminum rigid metal conduit is used.
  - 6. Use nonmetallic boxes where exposed rigid PVC conduit is used.
  - 7. Use suitable concrete type boxes where flush-mounted in concrete.
  - 8. Use suitable masonry type boxes where flush-mounted in masonry walls.
  - 9. Use raised covers suitable for the type of wall construction and device configuration where required.
  - 10. Use shallow boxes where required by the type of wall construction.
  - 11. Do not use "through-wall" boxes designed for access from both sides of wall.
  - 12. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  - 13. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
  - 14. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.

15. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
  16. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
  17. Minimum Box Size, Unless Otherwise Indicated:
    - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep trade size.
    - b. Communications Systems Outlets:
      - 1) Minimum 4 inch square by 2-1/8 inch trade size.
      - 2) Provide with single-gang drywall ring.
      - 3) Comply with Section 27 0533.
    - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep trade size.
  18. Wall Plates: Comply with Section 26 2726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches :
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    - a. Indoor Clean, Dry Locations: Type 1, painted steel.
    - b. Outdoor Locations: Type 3R, painted steel.
  3. Junction and Pull Boxes Larger Than 100 cubic inches :
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
  4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    - b. Back Panels: Painted steel, removable.
    - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
    - d. Provide with grounding stud.
    - e. Provide with document pocket in cover.
  5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
  6. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation
    - b. Hoffman, a brand of Pentair Technical Products
    - c. Hubbell Incorporated; Wiegmann Products
    - d. Substitutions: See Division 01 – General Requirements
- D. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
  2. Size: As indicated on drawings.
  3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
  4. Provide logo on cover to indicate type of service.

5. Applications:
  - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 15 load rating.
  - b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 22 load rating.
  - c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
  - a. Manufacturers:
    - 1) Hubbell Incorporated; Quazite Products
    - 2) NewBasis
    - 3) MacLean Highline
    - 4) Substitutions: See Division 01 – General Requirements
  - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

## 2.12 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).
- D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- E. Mechanical Sleeve Seals
- F. Manufacturers:
  1. Thunderline Link-Seal, Inc.
  2. NMP Corporation.
  3. PSI Link-Seal.
  4. Substitutions: See Division 01 – General Requirements
- G. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- H. Use: Provide for all penetrations through foundation walls.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. See Division 01 – General Requirements.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.
- C. Verify that field measurements are as shown on drawings.
- D. Verify that mounting surfaces are ready to receive conduits.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 260526.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 260529.
- C. Identify raceway and boxes in accordance with Section 260553.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Install products in accordance with manufacturer's instructions.
- F. Perform work in accordance with NECA 1 (general workmanship).
- G. Conduit Routing:
  - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
  - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
  - 3. Conceal all conduits unless specifically indicated to be exposed.
  - 4. Unless otherwise approved, do not route conduits exposed:
    - a. Across floors.
    - b. Across roofs.
    - c. Across top of parapet walls.
    - d. Across building exterior surfaces.
    - e. Interior finished spaces.
  - 5. Conduits installed underslab or embedded in concrete (see section 2.1 where applicable) may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
  - 6. Arrange conduit to maintain adequate headroom, clearances, and access.
  - 7. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
  - 8. Arrange conduit to provide no more than 150 feet between pull points.
  - 9. Route conduits above water and drain piping where possible.

10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
  11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
  12. Maintain minimum clearance of 12 inches between conduits and surfaces exceeding 104 degrees F. This includes, but is not limited to:
    - a. Heaters.
    - b. Hot water piping.
    - c. Flues.
  13. Group parallel conduits in the same area together on a common rack.
- H. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
  3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
  4. Use conduit strap to support single surface-mounted conduit.
  5. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
  6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
  7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
  8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
  9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
  10. Use of spring steel conduit clips for support of conduits is not permitted.
  11. Use of wire for support of conduits is not permitted.
- I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
  3. Use suitable adapters where required to transition from one type of conduit to another.
  4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
  5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
  6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs 6" above finished floor.
  7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
- J. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
  4. Conceal bends for conduit risers emerging above ground.
  5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
  6. Provide suitable mechanical sleeve seals where conduits penetrate exterior wall below grade.
  7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
  9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
  10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07 Section 07 8400.
- K. Underground Installation:
1. Provide trenching and backfilling in accordance with Division 31.
  2. Provide trenching and backfilling in accordance with Division 31.
  3. Minimum Cover, Unless Otherwise Indicated or Required:
    - a. Underground, Exterior: 24 inches.
    - b. Under Slab on Grade:
      - 1) Minimum 12 inches to bottom of slab.
      - 2) Depth as required to allow conduit to penetrate perpendicular to slab
  4. Provide underground warning tape (exterior below grade) in accordance with Section 260553 along entire conduit length except where concrete-encased.
- L. Water Prevention Measures:
1. Pitch all underground conduits such that they are angled downwards away from the building. Conduits shall not be pitched downwards toward the building, allowing ground water to enter conduit.
  2. Provide sealant for all active electric conduits containing conductors, equal to Polywater® FST™. Locate on both ends of each active conduit (at exterior enclosure and where conduit terminates in building). For spare conduits without conductors, provide cap at each end.
  3. All conduits (active and spare) shall sweep upward a minimum of 12" above the base of handholes or other exterior structures.
- M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Division 03 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

- N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
  - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  - 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  - 3. Where conduits are subject to earth movement by settlement or frost.
- O. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
  - 1. Where conduits pass from outdoors into conditioned interior spaces.
  - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- P. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- Q. Provide grounding and bonding in accordance with Section 260526.
- R. Identify conduits in accordance with Section 260553.
- S. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.

### 3.3 INSTALLATION – BOXES

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Install gang box with plaster ring for single device outlets.

- I. Box Locations:
  - 1. Locate boxes to be accessible. Provide access panels in accordance with Division 08 as required where approved by the Architect.
  - 2. Unless dimensioned, box locations indicated are approximate.
  - 3. Locate boxes as required for devices installed under other sections or by others.
    - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
    - b. Communications Systems Outlets: Comply with Section 270533.
  - 4. Locate boxes so that wall plates do not span different building finishes.
  - 5. Locate boxes so that wall plates do not cross masonry joints.
  - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
  - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
  - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
  - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
  - 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260534.
- J. Box Supports:
  - 1. Secure and support boxes in accordance with NFPA 70 and Section 260529.
  - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
  - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
  - 4. Install stamped steel bridges to fasten flush mounting outlet box between studs.
  - 5. Install adjustable steel channel fasteners for hung ceiling outlet box.
- K. Install boxes plumb and level.
- L. Flush-Mounted Boxes:
  - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
  - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
  - M. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Division 03.
  - N. Install boxes as required to preserve insulation integrity.
  - O. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
  - P. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.
  - Q. Underground Boxes/Enclosures:
    1. Install enclosure on gravel base, minimum 6 inches deep.
    2. Flush-mount enclosures located in concrete or paved areas.
    3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
    4. Provide cast-in-place concrete collar constructed in accordance with Division 03, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
    5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
  - R. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
  - S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07.
  - T. Close unused box openings.
  - U. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
  - V. Provide grounding and bonding in accordance with Section 260526.
  - W. Identify boxes in accordance with Section 260553.
- 3.4 INTERFACE WITH OTHER PRODUCTS
- A. Locate outlet boxes to allow luminaires positioned as indicated on reflected ceiling plan.
  - B. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- 3.5 ADJUSTING
- A. See Division 01 – General Requirements Adjust flush-mounting outlets to make front flush with finished wall material.

- B. Install knockout closures in unused openings in boxes.

### 3.6 CLEANING

- A. See Division 01 – General Requirements
- B. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.
- C. Clean exposed surfaces and restore finish.

### 3.7 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 260534  
FLOOR BOXES

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section includes floor boxes; floor box service fittings; poke-through fittings; and access floor boxes.
- B. Related Sections:
  - 1. Division 07 - Firestopping: Product requirements for firestopping for placement by this section
  - 2. Section 26 0533 - Raceway and Boxes for Electrical Systems.
  - 3. Section 26 2726 - Wiring Devices: Receptacles for installation in floor boxes.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for floor boxes service fittings.
- C. Samples: Submit two of each service fitting illustrating size, material, configuration, and finish.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of each floor box and poke-through fitting.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

## 1.7 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two protective rings.
- C. Furnish two carpet rings.

## PART 2 PRODUCTS

### 2.1 FLOOR BOXES

- A. Manufacturers:
  - 1. Legrand/Wiremold
  - 2. Leviton.
  - 3. Bryant.
  - 4. Hubbell.
  - 5. Substitutions: Division 01 - Product Requirements.
- B. Basis of design models:
  - 1. Legrand RFSB-OG series with RP4CT cover for power-only devices.
  - 2. Legrand EFBFF-OG series for furniture feed floor boxes.
  - 3. For devices containing power and low-voltage components, refer to drawings for basis of design model numbers.
- C. Floor Boxes: NEMA OS 1.
- D. For high capacity devices, power, data and AV outlets (as specified on drawings) shall be completely concealed and mounted on the side wall of floor box interior. Floor box shall utilize integral cable management with NO jacks being located on the top of the cover plate.
- E. Floor boxes shall use sliding covers, flip-up covers are not acceptable.
- F. Floor box shall be furnished with die cast aluminum cover assembly, with finish to be determined by architect.
- G. Conduits: Provide device capable of accepting the following conduit terminations:
  - 1. 3/4" for power.
  - 2. 1-1/4" for data/telecommunications.
  - 3. 2" for audiovisual.
- H. Furnish with necessary furniture feed accessories when connecting to modular furniture.
- I. Provide empty cover plates for sections without power/communication devices installed.
- J. Installation: Contractor is responsible of trenching from floor mounted fitting location to nearest wall.
- K. Provide final connections to furniture from furniture-feed devices as required by manufacturer.

## 2.2 POKE-THROUGH'S

- A. Manufacturers:
  - 1. Legrand/Wiremold
  - 2. Leviton.
  - 3. Bryant.
  - 4. Hubbell.
  - 5. Substitutions: Division 01 - Product Requirements.
- B. Basis of design models:
  - 1. Legrand RC9 for power-only devices.
  - 2. Legrand EFBFF series for furniture feed devices.
  - 3. For devices containing power and low-voltage components, refer to drawings for basis of design model numbers.
- C. Product Description: Assembly comprising of service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination.
- D. Provide connectors with sliding covers, flip-up covers are not acceptable.
- E. Fire rating to match that of floor.
- F. Service fitting type: Flushed.
- G. Conduits: Provide device capable of accepting the following conduit terminations:
  - 1. 3/4" for power.
  - 2. 1-1/4" for data/telecommunications.
  - 3. 2" for audiovisual.
- H. Provide empty cover plates for sections without power/communication devices installed.
- I. Core Drills: Contractor is responsible of providing 4" core drill for the installation of the assemblies described herein.
- J. Provide final connections to furniture from furniture-feed devices as required by manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify locations of floor boxes and outlets in offices, classrooms, laboratories and work areas prior to rough-in.
- C. Verify openings in access floor are in proper locations.

### 3.2 INSTALLATION

- A. Boxes and fittings are indicated on Drawings in approximate locations unless dimensioned. Adjust box location to accommodate intended purpose.

- B. Floor Box Requirements: Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- C. Set floor boxes level.
- D. Install boxes and fittings to preserve fire resistance rating of slabs and other elements, using materials and methods specified.
- E. Install protective rings on active flush cover service fittings.
- F. Coordinate installation of access floor boxes with access floor system and installing contractor.

### 3.3 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust floor box flush with finish flooring material.

### 3.4 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.3 RELATED REQUIREMENTS (follow the most currently adopted amended version)

- A. See Division 01 – General Requirements
- B. Division 09 - Finishes.
- C. Section 260400 – General Conditions for Electrical Trades.
- D. All of Divisions 26, 27 & 28.

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace
- E. UL 969 - Marking and Labeling Systems.

## 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
  - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
  - 2. Do not install identification products until final surface finishes and painting are complete.

## 1.6 SUBMITTALS

- A. See Division 01- General Requirements
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Division 01 – General Requirements
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

## 1.8 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

## 1.9 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature and humidity is lower than recommended by manufacturer.

## PART 2 PRODUCTS

### 2.1 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

- B. Identification for Equipment:
1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Panelboards:
      - 1) Identify panel name.
      - 2) Identify ampere rating.
      - 3) Identify voltage and phase.
      - 4) Identify power source and circuit number. Include location when not within sight of equipment.
      - 5) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
      - 6) Use typewritten circuit directory to identify load(s) served for panelboards with a door, including spares and spaces
    - b. Enclosed switches, circuit breakers, and motor controllers:
      - 1) Identify voltage and phase.
      - 2) Identify power source and circuit number. Include location when not within sight of equipment.
      - 3) Identify load(s) served. Include location when not within sight of equipment.
    - c. Enclosed Contactors:
      - 1) Identify ampere rating.
      - 2) Identify voltage and phase.
      - 3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
      - 4) Identify coil voltage.
      - 5) Identify load(s) and associated circuits controlled. Include location.
  2. Service Equipment:
    - a. Use identification nameplate to identify each service disconnecting means.
    - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
  3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
  4. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
  5. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
  6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
  7. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
  8. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
  9. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
  10. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.

- a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Division 09.
  11. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.
    - a. Service equipment.
    - b. Industrial control panels.
    - c. Motor control centers.
    - d. Elevator control panels.
    - e. Industrial machinery.
  12. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
    - a. Minimum Size: 3.5 by 5 inches.
    - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
    - c. Service Equipment: Include the following information in accordance with NFPA 70.
      - 1) Nominal system voltage.
      - 2) Available fault current.
      - 3) Clearing time of service overcurrent protective device(s).
      - 4) Date label applied.
  13. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
  14. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
  15. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
  16. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
  2. Identification for Communications Conductors and Cables: Comply with Section 270553.
  3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    - a. At each source and load connection.
    - b. Within boxes when more than one circuit is present.
    - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
    - d. In cable tray, at maximum intervals of 20 feet.
  5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
  6. Use underground warning tape to identify direct buried cables.
- D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
  2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
    - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
      - 1) Fire Alarm System: Red.
      - 2) Field-Painting: Comply with Division 09.
      - 3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
  3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
  4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
  5. Use underground warning tape to identify underground raceways.
  6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
  2. Use voltage markers or color coded boxes to identify systems other than normal power system.
    - a. Color-Coded Boxes: Field-painted in accordance with Division 09 per the same color code used for raceways.
      - 1) Fire Alarm System: Red.
    - b. For exposed boxes in public areas, do not color code.
  3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
    - a. For exposed boxes in public areas, use only identification labels.
  4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- F. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 270553.
  2. Wiring Device and Wallplate Finishes: Comply with Section 262726.
  3. Factory Pre-Marked Wallplates: Comply with Section 262726.
  4. Use identification label to identify fire alarm system devices.
    - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.

5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
    - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
  6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
  7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.
- G. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

## 2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Manufacturers:
    - a. Brimar Industries, Inc.
    - b. Kolbi Pipe Marker Co.
    - c. Seton Identification Products
    - d. Substitutions: Division 01 - General Requirements.
  2. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.
    - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
  3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
    - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
  4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
  5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
  6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Manufacturers:
    - a. Brady Corporation
    - b. Brother International Corporation
    - c. Panduit Corp.
    - d. Substitutions: Division 01 - General Requirements.
  2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
    - a. Use only for indoor locations.
  3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend:
    - a. System designation where applicable:
      - 1) Fire Alarm System: Identify with text "FIRE ALARM".
    - b. Equipment designation or other approved description.

- c. Other information as indicated.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height:
    - a. System Designation: 1 inch.
    - b. Equipment Designation: 1/2 inch.
    - c. Other Information: 1/4 inch.
    - d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
  5. Color:
    - a. Normal Power System: White text on black background.
    - b. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
  1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 1/4 inch.
  5. Color: Black text on white background unless otherwise indicated.
    - a. Exceptions:
      - 1) Provide white text on red background for general information or operational instructions for emergency systems.
      - 2) Provide white text on red background for general information or operational instructions for fire alarm systems.
- E. Format for Caution and Warning Messages:
  1. Minimum Size: 2 inches by 4 inches.
  2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 1/2 inch.
  5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
  1. Minimum Size: 3/8 inch by 1.5 inches.
  2. Legend: Power source and circuit number or other designation indicated.
    - a. Include voltage and phase for other than 120 V, single phase circuits.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch.
  5. Color: Black text on clear background.
- G. Format for Control Device Identification:
  1. Minimum Size: 3/8 inch by 1.5 inches.
  2. Legend: Load controlled or other designation indicated.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch.
  5. Color: Black text on clear background.
- H. Format for Fire Alarm Device Identification:
  1. Minimum Size: 3/8 inch by 1.5 inches.
  2. Legend: Designation indicated and device zone or address.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch.
  5. Color: Red text on white background.
  - 6.

## 2.3 WIRE AND CABLE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. HellermannTyton
  - 3. Panduit Corp.
  - 4. Substitutions: Division 01 - General Requirements.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
  - 1. Do not use self-adhesive type markers.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
  - 1. Do not use handwritten text.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

## 2.4 VOLTAGE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar Industries, Inc.
  - 3. Seton Identification Products
  - 4. Substitutions: Division 01 - General Requirements.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
  - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
  - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
  - 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
  - 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
  - 1. Markers for Voltage Identification: Highest voltage present.
- F. Color: Black text on orange background unless otherwise indicated.

## 2.5 UNDERGROUND WARNING TAPE

- A. Manufacturers:

1. Brady Corporation
  2. Brimar Industries, Inc.
  3. Seton Identification Products
  4. Substitutions: Division 01 - General Requirements.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil (0.1 mm), unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
1. Tape for Buried Power Lines: Black text on red background.
  2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

## 2.6 WARNING SIGNS AND LABELS

- A. Manufacturers:
1. Brimar Industries, Inc.
  2. Clarion Safety Systems, LLC.
  3. Seton Identification Products
  4. Substitutions: Division 01 - General Requirements.
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
1. Materials:
    - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
    - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
  2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
  3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
    - a. Do not use labels designed to be completed using handwritten text.
    - b. Provide polyester overlamine to protect handwritten text.
  2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
  3. Minimum Size: 2 by 4 inches unless otherwise indicated.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  - 1. Surface-Mounted Equipment: Enclosure front.
  - 2. Flush-Mounted Equipment: Inside of equipment door.
  - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  - 4. Elevated Equipment: Legible from the floor or working platform.
  - 5. Branch Devices: Adjacent to device.
  - 6. Interior Components: Legible from the point of access.
  - 7. Conduits: Legible from the floor.
  - 8. Boxes: Outside face of cover.
  - 9. Conductors and Cables: Legible from the point of access.
  - 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
  - 1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 12 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

### 3.3 FIELD QUALITY CONTROL

- A. See Division 01 - General Requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section Includes:
1. General Requirements
  2. Line Voltage Switches
  3. Line Voltage Dimmer Switches
  4. Switch Plates.
  5. Line Voltage Occupancy/Vacancy Sensor Switches
  6. Low Voltage Occupancy/Vacancy Sensors
  7. Photocells
  8. Room Controllers / Power Packs
  9. Low Voltage Keypads / Switches.
  10. UL 924 Bypass Relays
  11. Lighting Control Relay Panels
  12. Class 2 Conductors and Cables
- B. Related Sections:
1. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
  2. Section 26 05 19– Electrical Power Conductors and Cables.
  3. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Product requirements for raceway and boxes for placement by this section.
  4. Section 26 05 53 - Identification for Electrical Systems: Product requirements for electrical identification items for placement by this section.
  5. Section 26 24 16 - Panelboards.
  6. Section 26 27 26 - Wiring Devices: Product requirements for wiring devices for placement by this section.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
  2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  3. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
  4. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2015.

- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- F. IECC – International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### 1.4 SYSTEM DESCRIPTION

- A. IECC compliant lighting controls to control all interior and exterior lighting:
  - 1. Standalone lighting controls in individual spaces consisting of some combination of occupancy sensors, vacancy sensors, photocells, power packs, low voltage switches and low voltage switches with dimming capability.
  - 2. Standalone microprocessor based controllers with distributed switching control using self-contained individually mounted lighting relays. Provides multiple modes of operation incorporating vacancy sensors, photocells and low voltage control stations.
  - 3. Lighting control relay panels to control site lighting. Incorporates microprocessor local and centralized control, communications modules, bus connected sensors and control stations and power supplies.
- B. Refer to lighting control details and riser diagrams on the drawings for additional information.
- C. Provide automatic shutoff for lighting inside building, where required. Control shutoff by method conforming to IECC.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate the placement of wall switches with actual installed door swings and sidelights.
  - 3. Coordinate the placement of wall switch occupancy/vacancy sensors with actual installed door swings and sidelights.
  - 4. Coordinate the placement of occupancy/vacancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
  - 5. Coordinate the placement of photo sensors for daylighting controls 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.
  - 6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
  - 1. Protect lighting control devices during construction.

2. Clean lighting control devices once final surface finishes and painting are complete.

#### 1.6 SUBMITTALS

- A. See Division 01 - General Requirements.
- B. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
  1. One Line Diagram: Indicating system configuration, panels, number and type of switches or devices.
  2. Include typical wiring diagrams for each component.
  3. Floor Plan Layout Drawings: Manufacturers symbols are acceptable, provided that symbology between engineer's device legend and manufacturers symbols are cross-referenced.
- C. Product Data: Submit manufacturer's standard product data for each system component. This shall include, but not be limited to: ratings, configurations, dimensions, sensor coverage ranges, colors, service condition requirements, and installation features.
- D. Manufacturer's Installation Instructions: Submit for each system component.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections and evidence that the control schemes identified herein and shown on the typical lighting control details are configured and operational as specified.
  1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
  2. Provide documentation addressing each room/area control scheme specified with a description of how the submitted system complies.

#### 1.7 CLOSEOUT SUBMITTALS

- A. See Division 01 - General Requirements
- B. Project Record Documents: Record the following information:
  1. Actual installed locations of components and settings for lighting control devices. Record circuiting and switching arrangements.
  2. Wiring diagrams reflecting field-installed conditions with identified and numbered system components and devices.
- C. Operation and Maintenance Data:
  1. Submit replacement parts numbers.
  2. Submit manufacturer's published installation instructions and operating instructions.
  3. Recommended renewal parts list.
  4. Detailed information on device programming and setup.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience. Company shall provide 24/7 telephone support by qualified technicians.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- C. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.
- D. Contractor shall ensure that lighting system control devices and assemblies are fully compatible and can be integrated into a system that operates as described in the lighting control notes on drawings and as described within this specification. Any incompatibilities between devices, assemblies, and system controllers shall be resolved between the contractor and the system provider, as required to ensure proper system operation and maintainability.
- E. Performance Requirements: Shall provide all system components that have been manufactured, assembled, and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.
- F. Performance Testing Requirements
  - 1. Manufacturer shall 100% test all equipment prior to shipment. Sample testing is not acceptable.
- G. Code Requirements
  - 1. System Control Unit and System Field Devices shall be UL listed and certified.
  - 2. All system components shall be FCC / IC compliant.
  - 3. All system components shall be installed in compliance with National Electrical Codes.
  - 4. Building Codes: All units shall be installed in compliance with applicable, local building codes.

## 1.9 PRE-INSTALLATION MEETINGS

- A. See Division 01 - General Requirements.
- B. Convene minimum one week prior to commencing work of this section.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. See Division 01 - General Requirements.
- B. Accept components on site in manufacturer's packaging. Inspect for damage.
- C. Protect components by storing in manufacturer's containers indoor protected from weather.

1.11 WARRANTY

- A. See Division 01 - General Requirements.
- B. Furnish five year manufacturer warranty for all components.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two of each occupancy sensor type.
- C. Furnish two of each power pack type.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES – GENERAL REQUIREMENTS

- A. Manufacturers:
  - 1. nLight
  - 2. Hubbell
  - 3. Crestron
  - 4. Douglas
  - 5. Substitutions: See Division 01 – General Requirements.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- D. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.
- E. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- F. Refer to lighting control details on drawings for additional requirements and product specifications.

2.2 LINE VOLTAGE SWITCHES

- A. Manufacturers:
  - 1. Hubbell Incorporated
  - 2. Leviton Manufacturing Co., Inc.
  - 3. Pass and Seymour/Legrand
  - 4. Substitutions: Division 01 - General Requirements.
- B. Line Voltage Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6,

and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
  2. Body and Handle finish: Color selection by Architect.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

### 2.3 SWITCH PLATES

- A. Manufacturers:
1. Hubbell Incorporated
  2. Leviton Manufacturing Co., Inc.
  3. Pass and Seymour/Legrand
  4. Substitutions: [Division 01 - General Requirements] [Not Permitted].
    - a. Where low voltage keypads / switches or line voltage sensor switches are shown, provide switch plate by same manufacturer.
- B. Product Description: Specification Grade.
1. Material: Plastic.
  2. Color: By Architect.

### 2.4 LINE VOLTAGE OCCUPANCY/VACANCY SENSOR SWITCHES

- A. Manufacturers: See Paragraph 2.1(A)
- B. Product Description: Provide wall switch style occupancy/vacancy sensor capable of turning lights OFF when the space becomes unoccupied and ON when the space becomes re-occupied. Provide with 0-10V dimming capabilities and/or integral daylight control, where indicated on the drawings. Refer to drawings for occupancy or vacancy mode setting.
1. Material: Plastic.
  2. Color: By Architect.
- C. Sensor Switch Requirements:
1. Sensor switch shall be line voltage @ 120/277 VAC, rated for 20A.
  2. Sensor technology shall be dual technology: PIR and ultrasonic.
  3. Sensor shall have field of view of 180 degrees.
  4. Sensor switch shall be capable of operating with LED.
  5. Sensor switch shall be set to:
    - a. Auto-ON, Auto-OFF mode (Occupancy Sensor)
    - b. Manual-ON, Auto-OFF mode (Vacancy Sensor)
    - c. Dipswitch selectable to toggle between occupancy and vacancy mode.
  6. Sensor shall be capable of turning lights OFF after 20 minutes of inactivity. Switch shall also have 10 and 20 minute overrides.
  7. Provide device capable of accepting a 2-wire (hot and neutral) input plus ground.
  8. Sensor switch shall be capable of operating in conjunction with a 3-way switch per manufacturers requirements, where indicated on drawings.
  9. Provide with 0-10V dimming control, where noted on drawings.

## 2.5 LOW VOLTAGE OCCUPANCY/VACANCY SENSORS

- A. Manufacturers: See Paragraph 2.1(A)
- B. Product Description: Factory-assembled commercial grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated. Mounting as indicated on floor plans.
- C. Sensor Requirements:
  - 1. Sensor Technology:
    - a. Sensor shall be Dual Technology, unless otherwise noted on drawings.  
Available sensor technologies:
      - 1) Passive Infrared/Ultrasonic Dual Technology Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
      - 2) Passive Infrared/Acoustic Dual Technology Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
  - 2. Sensor shall be set to:
    - a. Auto-ON, Auto-OFF mode (Occupancy Sensor)
    - b. Manual-ON, Auto-OFF mode (Vacancy Sensor)
    - c. Dipswitch selectable to toggle between occupancy and vacancy mode.
  - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
  - 4. Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
  - 5. Passive Infrared Lens Field of View: Field customizable to block motion detection in selected areas.
  - 6. Sensor shall be capable of turning lights OFF after 20 minutes of inactivity. Switch shall also adjustable overrides.
  - 7. Sensitivity: Field adjustable.
  - 8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
  - 9. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
  - 10. Coverage:
    - a. Small Space (< 500 Sq Ft): 500 square feet minimum
    - b. Medium Space (500-1000 Sq Ft): 1,000 square feet minimum
    - c. Large Space (>1000 Sq Ft): 2,000 square feet minimum. Multiple sensors where shown on the plans.
  - 11. Furnish with power pack or room controller by same manufacturer.
    - a. Provide for zone control and maximum number of sensors connected to power pack per manufacturer's requirements.
    - b. Provide room controller with functions and quantity of zones as indicated on drawings and as required per manufacturer. Refer to Paragraph 2.9 for additional information.
  - 12. Operation: Silent.

## 2.6 POWER PACKS

- A. Manufacturers: See Paragraph 2.1(A)

- B. Refer to lighting control details on drawings for types, configurations, performance requirements, and additional information.
- C. Description: Integrated lighting, dimming, and equipment switching control system for mounting in a concealed space, enclosure shall be plenum rated. Provide pre-configured lighting controller(s), with capabilities for manual setup, and software setup through programming port, configured as a standalone controller.
  - 1. Room Controllers.
  - 2. Power Packs.
- D. Dimmable Load Types: 16A per channel at 100 to 277VAC, 50/60 Hz:
  - 1. 0 – 10V LED drivers.
- E. General Requirements:
  - 1. Power Packs:
    - a. Main Power: 100 – 277 VAC, 50/60 Hz.
    - b. Input/Output (Refer to Drawings and Details for Input/Output Applicable to Project):
      - 1) Line Power Inputs: 1.
      - 2) Switch Channel Outputs: As Indicated on Drawings.
      - 3) 0 – 10V Dimmer Outputs: As Indicated on Drawings. Class 1 or Class 2.
      - 4) Device Bussing, Provide control bussing for the following:
        - a) Low Voltage Keypads / Switches
        - b) Photocells / Daylight Sensors
        - c) Occupancy / Vacancy Sensors
        - d) Wiring: CAT X, Digital, or per manufacturers requirements.
      - 5) Auxiliary Relay for Interface with Other Systems.
      - 6) Auxiliary Inputs: Hold On/Hold Off as specified.
    - c. Enclosure: Plenum rated surface-mounted industrial control enclosure.
    - d. Control Processor:
      - 1) Integrates sensors and other low voltage controls, devices, and subsystems through multiple control interfaces with control network. Refer to drawings for functions and operation required by project.

## 2.7 LOW VOLTAGE KEYPADS / SWITCHES

- A. Provide low voltage keypads / switches with configuration, functionality and operation as indicated on drawings.
- B. General Requirements:
  - 1. Custom engravable buttons/switches, refer to drawings for labeling. Refer to Paragraph C below for additional requirements.
  - 2. Quantity and function as indicated on drawings.
  - 3. LED indicators, as shown on drawings.
  - 4. Configured to fit in standard gang boxes.
  - 5. Color: By Architect
- C. Labeling:
  - 1. Provide factory engraved labels for all low voltage keypads / switches buttons.

2. Refer to lighting control details on drawings for suggested labeling of lighting control equipment. Coordinate naming of scenes/control zones with the Owner. Provide a worksheet listing remote keypad controls, labeling requests and locations to the Owner for their labeling requests.
  3. Do not order labels until Owner coordination is complete.
- D. Lighting keypad shall be provided by the same manufacturer as the lighting control system.

## 2.8 UL 924 BYPASS RELAYS

- A. General Requirements:
1. Refer to drawings and details for required functions.
  2. The UL 924 Bypass Relay shall automatically illuminate connected emergency loads upon utility power interruption, regardless of room switch position. (NEC Article 700)
  3. The UL 924 Bypass Relay shall include an automatic diagnostic, which is initiated when the room switch is turned off. This test procedure will turn the emergency luminaires on for at least 2 seconds, indicating that an emergency power source is available & that the device, ballast, & lamp are all functioning correctly.
  4. Automatic diagnostic shall be approved to meet periodic testing requirements (NEC Article 700 NFPA 101 Chapter 7)
  5. Local room switch, dimmer or lighting keypad shall turn both regular & emergency luminaires on at the same time (no dedicated emergency room switch required).
  6. The UL 924 Bypass Relay shall include a dry contact for 0-10V override during utility power interruption, where indicated on drawings and details.
  7. The UL 924 Bypass Relay shall have a minimum load rating of 20 Amps at 120V or 277V, general use 20 Amps.
  8. The UL 924 Bypass Relay shall accept 120V & 277V 60 Hz Input & Output (voltage tolerance +/- 15%).
  9. The UL 924 Bypass Relay shall include emergency power and regular power indicator LED's and a manual test switch which are visible to room occupants when installed flush. (UL924 Section 29)
  10. Load contacts shall be able to withstand 10 direct shorts while connected to 20 Amp breaker without permanent damage.
  11. The UL 924 Bypass Relay shall not generate any objectionable electrical or mechanical noise.
  12. The UL 924 Bypass Relay shall mount inside a 4-11/16" junction box with an extension & single gang plaster ring.
  13. The UL 924 Bypass Relay shall be installed flush to the ceiling or above ceiling adjacent to load controlled, such that test switch & LED's are in plain view of room occupants as required by some local electrical codes.
  14. The UL 924 Bypass Relay shall have UL94-V0 or UL94-5VA flame rating & be approved for installation above the suspended ceiling

## 2.9 LIGHTING RELAY PANELS

- A. Manufacturers: See Paragraph 2.1(A)

- B. Product Description: Standalone relay panel with quantity of relays as indicated on drawings. Standalone panel shall utilize a digital controller with LCD screen and numerical keypad.
- C. All components are to be supplied by the same manufacturer. The manufacturer shall be a supplier of this type of equipment for over 5 years.
- D. Relay Panel shall come pre-assembled complete with Relays, Transformer & Timeclock.
- E. Relays mounted in the lighting control panels shall be full load relays suitable for all types of lamp loads up to 20 Amperes. Relays shall be mechanically latching and must have a physical ON/OFF override built into the relay.
- F. Time Controls shall be a 365 Day Astronomical Timer for switching, 2-Wire Relays. Programming shall be accomplished by entering data on a membrane key pad with an LCD graphic display. Any output shall be time, astro, photo-controlled or combination photo/time or astro/time controlled. There shall be available up to 500 events per week and 32 holiday programs. The controllers memory and time are not lost when power fails. Programs are held indefinitely and time is held for 72 hours.
- G. Provide with inputs for each relay for manual override and programmable control of associated relays or groups of relays.
- H. Provide with "BLINK" warning to blink the lights prior to expiration (off control) of a relay or groups of relays via time schedule.
  - 1. When manual override control is activated relay or relay group shall remain on for up to two hours (programmable).
  - 2. Relay or groups of relays shall sweep off every two hours until next time scheduled event.
- I. Provide manual override low-voltage switches by same manufacturer in locations indicated on drawings.

## 2.10 CLASS 2 CONDUCTORS AND CABLES

- A. General Requirements:
  - 1. Line Voltage Wiring: Comply with requirements of Division 26 Section "Electrical Power Conductors and Cables".
  - 2. Class 2 Low-Voltage Cable:
    - a. Provide plenum-rated cable.
    - b. UTP Cable: CAT 5, CAT 6, or as required by manufacturer:
      - 1) Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      - 2) All cabling shall meet or exceed Commercial Building Telecommunications Cabling Standard ANSI/TIA/EIA 568-C.2
      - 3) Cabling shall use 23AWG minimum conductors.
      - 4) Pulling tension: The cable pulling tension shall not exceed 25 ft/lbs as indicated in TIA/EIA-568-A.
    - c. Control Cable:
      - 1) Stranded copper cable, Type CMP.
        - a) Multiple-Conductor.
        - b) Twisted Pair.

- c) Shielded Twisted Pair
- d) Minimum AWG: Per manufacturer requirements, as shown on drawings and details.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Site Verification:
  - 1. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instruction.
  - 2. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
  - 3. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
  - 4. Verify that final surface finishes are complete, including painting.
  - 5. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
  - 6. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
  - 7. Verify that conditions are satisfactory for installation prior to starting work.
- B. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.3 INSTALLATION

- A. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control as described herein and shown on the plans (including but not limited to System Field Devices, 0-10V dimming ballasts, fixed output ballasts, 0-10V LED drivers and communication wire). The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.
- B. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards, unless otherwise indicated. Install per manufacturer's instructions.
- C. Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.

- D. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- E. Install wiring in accordance with Section 260519 and paragraph 2.13.
- F. Use only properly color coded, stranded wire. Install wire sizes as indicated on Drawings. Install wire in conduit in accordance with Section 260533 and paragraph 2.13.
- G. Mount relay panel as indicated on Drawings. Wire numbered relays in panel to control power to each load.
- H. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- I. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.
- J. Label each low voltage wire with relay number at each switch or sensor. Refer to Section 26 05 53.
- K. Coordinate locations of outlet boxes provided under Section 260533 as required for installation of lighting control devices provided under this section.
- L. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
- M. Prior to setting scenes or zones dependent on furniture placement, whiteboard locations, projection screen locations, lectern locations or similar, coordinate with the Owner, Architect and red-lined furniture plans. Make all required adjustments during construction.
- N. Systems Integration:
  - 1. Equipment Integration Meeting:
    - a. Facility Representative to coordinate meeting between Facility Representative, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures prior to system startup
- O. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- P. Install lighting control devices plumb and level, and held securely in place.
- Q. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- R. Identify lighting control devices in accordance with Section 260553.

- S. Unless otherwise indicated, install power packs/room controllers for lighting control devices within the same space above accessible ceiling or above access panel in inaccessible ceiling.
- T. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

### 3.4 SENSOR INSTALLATION:

- A. Adjust sensitivity to cover area installed
- B. Set time delay on sensors that are connect to the lighting control system to the minimum. Time delay to off shall be set to no longer than 20 minutes.
- C. Provide vacancy sensor configurations as indicated on drawings.
- D. Install sensors on vibration free stable surface.
- E. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
- F. Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
- G. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors away from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- H. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on sensor lenses to block undesired motion detection.

### 3.5 MANUFACTURER'S FIELD SERVICES

- A. Division 01 - General Requirements.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following field tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing wall stations and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
  - 4. Adjust relay panel settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings and as-built relay panel schedules in written report, to be included with submittals.

- D. Lighting control devices will be considered defective if they do not pass tests and inspections.

### 3.6 FIELD QUALITY CONTROL

- A. Division 01 - General Requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Correct wiring deficiencies and replace damaged or defective lighting control devices.

### 3.7 ADJUSTING

- A. Division 01 - General Requirements.
- B. Test contactors and switches after installation to confirm proper operation.
- C. Confirm correct loads are recorded on directory card in each panel.
- D. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

### 3.8 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### 3.9 COMMISSIONING

- A. Division 01 - General Requirements.

### 3.10 DEMONSTRATION

- A. Division 01 - General Requirements.
- B. Demonstrate proper operation of lighting control devices to Architect and Owner, and correct deficiencies or make adjustments as directed.
- C. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of four hours of training.
  - 3. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.
  - 4. Instructor: Qualified manufacturer's representative familiar with the project and with sufficient knowledge of the installed lighting control devices.
- D. Duration of Training: Four(4) hours.

END OF SECTION

SECTION 262416

PANELBOARDS

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Division 03 - Cast-in-Place Concrete: Concrete equipment pads.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.4 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service..
- B. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NEMA FU 1 – Low Voltage Cartridge Fuses.
- E. NECA 407 - Standard for Installing and Maintaining Panelboards.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- H. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

- I. NEMA PB 1 - Panelboards.
- J. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- K. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- N. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- O. UL 67 - Panelboards; Current Edition, Including All Revisions.
- P. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- Q. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- R. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- S. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.
- T. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- U. UL 1699 - Arc-Fault Circuit-Interruption; Current Edition, Including All Revisions.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
  - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

#### 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
  - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 4. Include documentation of listed series ratings upon request.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

#### 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

## 1.9 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
  - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
  - 2. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.

## 1.10 WARRANTY

- A. General: See Division 1 – Closeout Procedures.
- B. Special Warranty: Submit a written warranty executed by the manufacturer, the Installer, and the Contractor, agreeing to repair or replace panelboards with branch metering that fail in materials or workmanship within the specified warranty period.
  - 1. Warranty Period: Warranty period shall be one year from the date of installation or 18 months from date of purchase.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. ABB/GE.
- B. Eaton Corporation.
- C. Schneider Electric; Square D Products.
- D. Siemens Industry, Inc.
- E. Substitutions: See Division 01 - Product Requirements.
- F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

### 2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature:
    - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
    - b. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F
- C. Short Circuit Current Rating:
  - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
  - 2. Listed series ratings are acceptable.

3. Label equipment utilizing series ratings as required by NFPA 70.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
  1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
  3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
  2. Outdoor Locations: Type 3R.
    - a. Furnish thermostatically controlled electric heaters sized to prevent condensation under expected weather conditions at Project site. Furnish control power transformer and terminals for separate connection of heater power circuit.
  3. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
    - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
    - c. Provide removable end walls for NEMA Type 1 enclosures.
    - d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
  4. Fronts:
    - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
    - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
    - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
  5. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided, list and label panelboards as a complete assembly including surge protective device.

- L. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- M. Load centers are not acceptable.
- N. Provide the following features and accessories where indicated or where required to complete installation:
  - 1. Feed-through lugs.
  - 2. Sub-feed lugs.

### 2.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
  - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
  - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
  - 2. Phase and Neutral Bus Material: Tin plated copper
  - 3. Ground Bus Material: Copper
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
  - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
  - 2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
  - 3. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
  - 4. Provide clear plastic circuit directory holder mounted on inside of door.

### 2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
  - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
  - 2. Interrupting Capacity:
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      - 2) 14,000 rms symmetrical amperes at 480 VAC.
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  - 3. Conductor Terminations:
    - a. Provide mechanical lugs unless otherwise indicated.
    - b. Provide compression lugs where indicated.

- c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
  - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
  - b. Provide interchangeable trip units where indicated.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
  - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
  - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

## 2.5 SOURCE QUALITY CONTROL

- A. See Division 01 – General Requirements.
- B. Factory test panelboards according to NEMA PB 1.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required supports in accordance with Section 260529.
- F. Install panelboards plumb.

- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 260526.
  - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
  - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- K. Install all field-installed branch devices, components, and accessories.
- L. Install a permanent label indicating the panelboard or transformer where the power supply to the panel originates.
- M. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- N. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- O. Provide filler plates to cover unused spaces in panelboards.
- P. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
  - 1. Emergency and night lighting circuits.
  - 2. Fire detection and alarm circuits.
- Q. Identify panelboards in accordance with Section 260553.

### 3.3 FIELD QUALITY CONTROL

- A. See Division 01 - General Requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 800 amperes. Tests listed as optional are not required.
  - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
  - 2. Test functions of the trip unit by means of secondary injection.
- D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.
- E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. See Division 01 – General Requirements.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- C. Adjust alignment of panelboard fronts.
- D. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. See Division 01 – General Requirements.
- B. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- C. Repair scratched or marred exterior surfaces to match original factory finish.

3.6 PROTECTION

- A. Protect installed panelboards from subsequent construction operations.

END OF SECTION

SECTION 262726

WIRING DEVICES

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Division 09 - Finishes
- C. Section 260400 – General Conditions for Electrical Trades
- D. Section 260519 - Electrical Power Conductors and Cables.
- E. Section 260526 - Grounding and Bonding for Electrical Systems.
- F. Section 260503 – Equipment Wiring Connections.
- G. Section 260533 – Raceways and Boxes for Electrical Systems.
- H. Section 260553 - Identification for Electrical Systems.
- I. Section 260923 - Lighting Control Devices.
- J. Section 26 0534 - Floor Boxes for Electrical Systems: Service fittings for receptacles installed on floor boxes.
- K. Section 26 0534 - Floor Boxes for Electrical Systems: Poke-through receptacles.

1.4 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Revision H.

- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Revision G.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.
- K. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
  - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
  - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
  - 5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
  - 1. Do not install wiring devices until final surface finishes and painting are complete.

#### 1.6 SUBMITTALS

- A. See Division 01 - General Requirements.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
  - 1. Wall Dimmers: Include derating information for ganged multiple devices.
  - 2. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.
- C. Samples: One for each type and color of device and wall plate specified.
- D. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.

- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data:
  - 1. GFCI Receptacles: Include information on status indicators.
- G. Project Record Documents: Record actual installed locations of wiring devices.

## 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

## PART 2 PRODUCTS

### 2.1 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for receptacles where indicated on the drawings.
- E. Provide GFCI protection for receptacles installed within 6 feet of water source.
- F. Provide GFCI protection for receptacles installed in dwelling unit kitchens.
- G. Provide GFCI protection in other than dwelling units for all single-phase receptacles rated 150 volts to ground or less and all three-phase receptacles rated 150 volts to ground or less, 100 amperes or less in: Bathrooms, Kitchens and on Rooftops
- H. Provide GFCI protection for receptacles serving electric drinking fountains.

I. Unless noted otherwise, do not use combination switch/receptacle devices.

2.2 WALL SWITCHES: See Section 260923 – Lighting Control Devices for specifications.

## 2.3 RECEPTACLES

### A. Manufacturers:

1. Hubbell Incorporated
2. Leviton Manufacturing Company, Inc.
3. Pass & Seymour, a brand of Legrand North America, Inc.
4. Substitutions: See Division 01 - General Requirements.
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

### B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.
3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.
4. Body color:
  - a. General Purpose Receptacles: color by Architect.
  - b. Emergency, [Critical Branch], [Equipment Branch] receptacles: Red.

### C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

### D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
  - a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

### E. USB Charging Devices:

1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
2. Combination Duplex Receptacle: Provide with One USB Type-A and one USB Type-C charging port. Provide with 5-Amp, 5-Volt USB output. Provide Hubbell USB20AC5W or equal.

## 2.4 WALL PLATES

### A. Manufacturers:

1. Hubbell Incorporated
2. Leviton Manufacturing Company, Inc.

3. Pass & Seymour, a brand of Legrand North America, Inc.
  4. Substitutions: See Division 01 - General Requirements.
  5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
  2. Screws: Metal with slotted heads finished to match wall plate finish.
  3. Provide screwless wallplates with concealed mounting hardware where indicated.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

#### 3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533 as required for installation of wiring devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:
    - a. Wall Switches: 48 inches above finished floor.
    - b. Receptacles: 18 inches above finished floor or 6 inches above counter.
    - c. Install convenience GFCI type receptacles 36 to 48 inches above roof deck.
    - d. Or at designated heights as indicated on drawings.
  2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
  3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
  4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
  5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in special application enclosures per manufacturer's instructions, provide stainless steel cover plates.
- D. Install wiring devices in accordance with manufacturer's instructions.
- E. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- F. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- G. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- H. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper. When stranded conductors are used in lieu of solid, use insulated crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screw terminals.
- I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- J. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- K. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- L. Install wall switches with OFF position down.
- M. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- N. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- O. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed

outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

- P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- Q. Identify wiring devices in accordance with Section 260553.

### 3.4 FIELD QUALITY CONTROL

- A. See Division 01 - General Requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI protected receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

### 3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

### 3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 28 19  
ENCLOSED SWITCHES

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section includes nonfusible switches.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
  - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 PRODUCTS

2.1 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
  - 1. General Electric.
  - 2. Square D.

3. Siemens.
  4. Eaton/Cutler Hammer.
  5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: NEMA KS 1, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray
1. Interior Dry Locations: Type 1.
  2. Exterior Locations: Type 3R.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.
- F. Switch Rating: As indicated on drawings.
- G. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet to operating handle.
- C. Install engraved plastic nameplates in accordance with Section 26 05 53.
- D. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.
- E. For switches feeding mechanical equipment, install switch within sight of the equipment.

#### **3.2 COORDINATION WITH OTHER TRADES**

- A. It is the responsibility of the electrical contractor to furnish and install a safety switch for each electrical connection to mechanical equipment in the project, unless otherwise noted in the drawings.
- B. It is the responsibility of the electrical contractor to install all safety switches furnished under DIVISION 23 – MECHANICAL WORK, DIVISION 22 – PLUMBING WORK, AND DIVISION 21 – FIRE PROTECTION. Items with loose switches furnished by other trades are notated in drawings.
- C. Coordination between electrical and mechanical trades shall be anticipated.

#### **3.3 FIELD QUALITY CONTROL**

- A. Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

**END OF SECTION**

SECTION 26 5100  
LIGHTING

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Interior luminaires.
- B. Exterior luminaires.
- C. Exit signs.
- D. Central Lighting Inverters.

1.3 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- C. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.
- D. Lighting Fixture Schedule as indicated on drawings.

1.4 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.
- E. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2015.
- F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

- G. UL 924 Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
  - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
  - 3. Coordinate placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility, installed by other sections or others.
  - 4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

#### 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.
- B. Shop Drawings:
  - 1. Indicate dimensions and components for each luminaire of the manufacturer.
  - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Shop Drawings: For nonstandard or custom luminaires.
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- D. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  - 5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA LM-79 and IESNA LM-80.
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

- b. Testing Agency Certified Data: Photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  - c. TM-21 report for L70 rating at color temperature specified.
- E. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
- F. Field quality control reports.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

#### 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.8 QUALIFICATION DATA: For testing laboratory providing photometric data for luminaires.

- A. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

#### 1.9 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

## 1.10 FIELD CONDITIONS

- A. Maintain field conditions within the manufacturer's required service conditions during and after installation.

## 1.11 WARRANTY

- A. See Division 01 – General Requirements.
- B. Section 26 0400 – General Requirements for Electrical Trades.
- C. Unless otherwise noted in Lighting Fixture Schedule, Provide **FIVE year** manufacturer warranty for all LED luminaires, including drivers.

## PART 2 PRODUCTS

### 2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in Lighting Fixture Schedule included on the drawings.
- B. Substitutions:
  - 1. Substitutions are not permitted where indicated as such on the drawings. These products shall be considered the Basis of Design.
  - 2. Where substitutions are permitted:
    - a. Approved equals to the basis of design fixture listed in the Lighting Fixture Schedule shall be accepted for review with the proposed substitute fixture meeting the following minimum requirements:
      - 1) Be of the same general size, style and shape, including but not limited to lens construction and shading.
      - 2) Be of equal or better quality and construction.
      - 3) Be supplied with all required accessories to match the specified fixture.
      - 4) Be supplied with all remote drivers, power supplies and cabling lengths to meet specified performance and control.
      - 5) Provide the same or better distribution, efficiency, source lumen output, and L70 lumen depreciation metric.
    - b. Provide point by point photometric calculations at the request of the Engineer for evaluation.
    - c. The basis of design fixture listed in the Lighting Fixture Schedule lists part numbers, specifications, options, accessories and source output available at the time of design. Substitutions shall meet these requirements as scheduled.
    - d. The evaluation of an approved equal shall be at the sole discretion of the Architect and Engineer.

### 2.2 INTERIOR LUMINAIRES

- A. Manufacturers: See paragraph 2.1.
- B. Provide products that comply with requirements of NFPA 70.

- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Recessed Luminaires:
  - 1. Ceiling Compatibility: Comply with NEMA LE 4.
  - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
  - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- I. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.
- K. Luminaires in Special Environments:
  - 1. Wet Locations: Provide with sealed and gasketed lens.

## 2.3 EXIT SIGNS

- A. Manufacturers: See paragraph 2.1.
- B. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
  - 1. Number of Faces: Single or double as indicated or as required for the installed location.
  - 2. Directional Arrows: Universal type for field adjustment sized so that they are clearly visible at a distance of 40 feet as required by local codes.
  - 3. Mounting: Wall, ceiling or pendant as indicated. Provide universal mount exit signs where indicated.
  - 4. Housing: Varies, refer to Lighting Fixture Schedule.
  - 5. Face: Varies, refer to Lighting Fixture Schedule.
- C. Special Wording Signs: Provide with special wording as indicated.
  - 1. Where indicated, provide with international symbol of accessibility complying with state and local codes.

## 2.4 EXTERIOR LUMINAIRES

- A. Manufacturers: See paragraph 2.1.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Provide products complying with Federal Energy Management Program (FEMP) requirements.
- F. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, drivers, reflectors, lenses, housings, poles, brackets, bases, vibration dampers, isolation pads and other components required to position, energize and protect the lamp and distribute the light.
- G. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- H. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- I. Provide IESNA full cut-off classified products unless otherwise indicated or provide products with backlight, upright and glare (BUG) ratings as indicated.
- J. Provide products with IESNA light distribution as indicated.
- K. Provide products with internal/external house-side shields as indicated.
- L. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data or as indicated.
- M. Poles:
  - 1. Material and Finish: Refer to Lighting Fixture Schedule.
  - 2. Section Shape and Dimensions: Per drawings.
  - 3. Height: As indicated on Drawings or as scheduled.
  - 4. Base: Breakaway
  - 5. Accessories:
    - a. Handhole.
    - b. Anchor bolts.
    - c. Base Cover.
  - 6. Loading Capacity Ratings:
    - a. Provide with EPA rating suitable for maximum wind load in area, including EPA for attached luminaires and all required accessories.
    - b. Consult with local authorities for wind loading requirements.

## 2.5 MATERIALS

### A. Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.
4. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
5. Diffusers and Globes:
  - a. Refer to Interior Lighting Fixture Schedule for types.
  - b. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - c. Glass: Annealed crystal glass unless otherwise indicated.
  - d. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
6. Housings:
  - a. Extruded-aluminum housing and heat sink unless otherwise indicated.
  - b. Powder-coat finish unless otherwise indicated, color selection by Architect.
7. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - a. Label shall include the following lamp characteristics:
    - 1) "USE ONLY" and include specific lamp type.
    - 2) Lamp diameter, shape, size, wattage, and coating.
    - 3) CCT and CRI for all luminaires.

### B. METAL FINISHES

1. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.6 LED DRIVERS

### A. Manufacturers:

1. eldoLED.
2. General Electric Company.
3. Lutron Electronics Company.
4. Osram Sylvania.
5. Substitutions: See Division 01- General Requirements, Product Requirements.
6. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
7. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
8. Provide ballasts/drivers compatible with the approved lighting control systems.

### B. Drivers - General Requirements:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

- C. LED Drivers:
1. Product Description: LED dimming driver.
    - a. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers
    - b. Digital (DALI Low Voltage Controlled) Dimming Drivers
    - c. Digital Multiplex (DMX Low Voltage Controlled) Dimming Drivers
  2. General:
    - a. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
    - b. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
    - c. Driver must limit inrush current.
      - 1) Base specification: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps<sup>2</sup> – seconds.
      - 2) Preferred Specification: Meet or exceed 30mA<sup>2</sup>s at 277VAC for up to 50 watts of load and 75A at 240us at 277VAC for 100 watts of load.
    - d. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
    - e. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
    - f. Total Harmonic Distortion less than 20% percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.
    - g. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
      - 1) Adjustment of forward LED voltage, supporting 3V through 55V.
      - 2) Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA
      - 3) Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
    - h. Driver must be able to operate for a (+/- 10%) supply voltage of 120V through 277VAC at 60Hz.
    - i. Driver should be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
    - j. Driver shall include ability to provide no light output when the analog control signal drops below 0.5 V, or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.
  3. Light Quality
    - a. Over the entire range of available drive currents, driver shall provide step-free, continuous dimming to black from 100 percent to 1 percent and 10% relative light output where indicated, or 100 – 10% light standard. Driver shall respond similarly when raising from 1% to 100%

- b. 1) Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels
  - c. Drivers to track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
  - d. Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-1 percent luminaire shall have:
    - 1) LED dimming driver shall provide continuous step-free, flicker free dimming similar to incandescent source.
    - 2) Base specification: Flicker index shall less that 5% at all frequencies below
    - 3) 1000 Hz.
    - 4) Preferred specification: Flicker index shall be equal to incandescent, less that 1% at all frequencies below 1000 Hz.
4. Control Input
- a. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers
    - 1) Must meet IEC 60929 Annex E for General White Lighting LED drivers
    - 2) Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
    - 3) Must meet ESTA E1.3 for RGBW LED drivers
  - b. Digital (DALI Low Voltage Controlled) Dimming Drivers
    - 1) Must meet IEC 62386
  - c. Digital Multiplex (DMX Low Voltage Controlled) Dimming Drivers
    - 1) Must meet DMX / RDM: USITT DMX512A and ANSI E1.20 (Explore & Address)
    - 2) Capable of signal interpolation and smoothing of color and intensity transitions
5. Driver: Approved by dimming system manufacturer as suitable for operation with control unit and suitable for LED source type and quantity specified for luminaire.

## 2.7 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 “Hangers and Supports for Electrical Systems” for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with heavy duty swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage minimum.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.
- F. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

## 2.8 CENTRALIZED MODULAR EMERGENCY LIGHTING INVERTERS

- A. Manufacturers
  - 1. Isolite.
  - 2. Inverter Systems, Inc.
  - 3. Dual-Lite.
  - 4. Substitutions – See Division 1, Product Requirements.
- B. Provide UL924 listed modular sine wave inverter for centralized applications, capable of switching to emergency lighting power in 10 seconds or less.
- C. VA Rating: As indicated on drawings.
- D. Input voltage: As indicated on drawings.
- E. Output voltage: 120V-1Ø, As indicated on drawings.
- F. Output circuit breakers: Provide number of circuit breakers as indicated on drawings. Provide with normally on circuit breakers.
  - 1. Inverters with output less than 2 KVA shall be provided with a minimum of four(4) output circuit breakers.
  - 2. Inverters with output of 2 KVA or more shall be provided with a minimum of six(6) output circuit breakers.
- G. Units shall be free-standing devices, mounted in locations shown on drawings. Modular units with more than one cabinet shall be vertically stacked.
- H. Provide with standard factory start-up services.
- I. Provide eight(8) hours of training to owner, regarding standard operation, system maintenance and required yearly testing procedures.
- J. Provide all necessary emergency lighting relays to automatically switch inverter lighting loads on in the event of a power failure. Where not shown on drawings, include 1 relay for each inverter output circuit, mounted adjacent to inverter.

## PART 3 EXECUTION

### 3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, and accessories.
- B. Extend existing luminaire, emergency lighting and exit sign installations using materials and methods compatible with existing installations, or as specified.
- C. Clean and repair existing luminaires, emergency lighting units and exit signs to remain or to be reinstalled.
- D. Relamp existing luminaires and test at substantial completion.
- E. Test all existing battery units, repair or replace at substantial completion.

### 3.2 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.3 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.4 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires, emergency lighting units and exit signs provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Suspended Ceiling Mounted Luminaires:
  - 1. Do not use ceiling tiles to bear weight of luminaires.
  - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
  - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
  - 4. Secure pendant-mounted luminaires to building structure.
    - a. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 5. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box, heavy-duty swivel hangers and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 6. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  - 7. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.

8. See Division 09 - Finishes where suspended grid ceiling is specified for additional requirements.
- G. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
  2. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
  3. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
  4. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
  5. Install recessed luminaires to permit removal from below.
- H. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
  2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
  3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
  4. Install canopies tight to mounting surface.
  5. Secure pendant-mounted luminaires to building structure.
    - a. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  6. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box, heavy-duty swivel hangers and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  7. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  8. Unless otherwise indicated, support pendants from swivel hangers.
- I. Exterior Luminaires:
1. Install concrete bases for lighting poles at locations as indicated on Drawings, in accordance with Division 03 - Concrete.
  2. Verify foundations are ready to receive luminaires.
  3. Install poles plumb. Grout around each base.
  4. Set pole with integral handhole 180 degrees opposite of drive lane, parking lot or curb line.
  5. Install vibration dampers and isolation pads as indicated.
  6. Install lamps in each luminaire.
  7. Bond and ground luminaries in accordance with Section 26 05 26.
  8. Aim and adjust luminaires with distribution aimed towards coverage area and parallel to curb line or to provide illumination levels and distribution as indicated.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
  2. Install lock-on device on branch circuit breaker serving units.
  3. Install plumb and adjust to align with building lines and with each other. Secure to prevent movement.
  4. Install suspended exit signs using pendants from swivel hangers. Install pendant lengths required to suspend sign at height indicated or as instructed by the Authority Having Jurisdiction.
- N. Identify luminaires connected to emergency power system in accordance with Section 26 0553.
- O. Install accessories furnished with each luminaire.
- P. Connect luminaires to branch circuit using flexible conduit, except for emergency lighting which shall be in conduit completely.
- Q. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- R. Ground and bond interior luminaires in accordance with Section 26 05 26.

### 3.5 FIELD QUALITY CONTROL

- A. See Division 01 – General Requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

### 3.6 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Air-Handling Luminaires with Air Control Blades or Heat Removal Dampers: Adjust as indicated or as required for proper airflow as directed by Architect.
- D. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

### 3.7 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean photometric surfaces as recommended by the manufacturer.

### 3.8 CLOSEOUT ACTIVITIES

- A. See Division 01- General Requirements
- B. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- C. Just prior to Substantial Completion, replace all lamps that have failed.

### 3.9 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION**

SECTION 27 05 29

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Support and attachment components for communications equipment, conduit, cable, boxes, and other communications work.

1.3 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Division 03 - Cast-in-Place Concrete: Concrete equipment pads.
- C. Section 260400 – General Conditions for Electrical Trades
- D. Section 260529 – Hangers and Supports for Electrical Systems
- E. Section 271000 – Structured Cabling

1.4 REFERENCE STANDARDS

- A. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

## 1.5 ADMINISTRATIVE REQUIREMENTS

- A. See Division 01: General Requirements.
- B. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components being installed.
  - 2. Coordinate the work with other trades and provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- C. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.

## 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Installer's Qualifications: Include evidence of compliance with specified requirements.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

## 1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with latest adopted version of applicable building code, including any addendum or supplements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding: As specified in Section 260400 General Requirements for Electrical Trades.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

2.1 Refer to Section 260529 – Hangers and Supports for Electrical Systems. All Part 2 Product requirements listed in this Section shall also apply to Division 27 Communications, except where specified otherwise herein.

## 2.2 J-HOOK SUPPORTS

- A. Manufacturers:
  - 1. Easton/Cooper B-Line – “BCH” Series
  - 2. Caddy
  - 3. Chatsworth
  - 4. Substitutions: Division 01 - General Requirements
- B. Product Description: Low-voltage and communication fasteners for routing of cabling from telecommunication room to work area outlet. J-hooks shall support all communications cabling in the project. Including, but not limited to, Category 6, 6A, fiber, speaker cabling, coaxial, security, and others.
- C. Specifications:
  - 1. Pre-galvanized steel finish
  - 2. Static load capacity: 30 lbs
  - 3. Quick latching cable retainer
- D. Furnish with all required connectors, fasteners and accessories.
- E. J-Hooks shall be sized to correctly support the number of cables, which pass through them. Under no circumstances shall cable quantity exceed 50 in any given support. Fill capacity shall be as required by code for conduit. That is to say that every J-Hook shall have a maximum of 40 percent fill capacity. Install additional supports as required.

## PART 3 EXECUTION

3.1 Refer to Section 260529 – Hangers and Supports for Electrical Systems. All Part 3 Execution requirements listed in this Section shall also apply to Division 27 Communications, except where specified separately herein.

## 3.2 INSTALLATION – COMMUNICATIONS SYSTEM SUPPORT COMPONENTS

- A. Backboxes for communications devices shall be permitted to be supported from a grid ceiling. A tile bridge shall be furnished for this purpose. Refer to Section 26 05 33.
- B. Overhead speakers, plenum boxes, audiovisual equipment, and other devices weighing more than a standard electrical backbox shall be supported via a threaded rod fastened to the building structure.
- C. J-hooks shall be furnished with cable-to-beam fasteners and shall be fastened to the building structure.

- D. Separate J-hooks shall be furnished and installed for different systems. The following systems shall be routed in separate j-hook pathways:
  - 1. Data cabling
  - 2. Speaker cabling
  - 3. Security cabling
  
- E. J-hook pathways shall be separated from power cabling by a minimum of 12 inches.
  
- F. J-hook pathways shall be separated from the load side wiring of dimmer controls by a minimum of 24 inches.

END OF SECTION

SECTION 27 05 33

RACEWAY AND BOXES FOR COMMUNICATIONS SYSTEMS

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section Includes:
1. Raceway and Boxes for Communications Systems.
- B. Related Sections:
1. Section 260400 – General Conditions for Electrical Trades.
  2. Section 260526 - Grounding and Bonding for Electrical Systems.
  3. Section 260533 - Raceway and Boxes for Electrical Systems.
  4. Section 260534 - Floor Boxes for Electrical Systems.
  5. Section 270529 - Hangers and Supports for Communications Systems.
  6. Section 270553 - Identification for Communications Systems.

1.3 REFERENCES

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC);
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S);
- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A);
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction;
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT);
- F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit;
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC);
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable;
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit;
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing;

- K. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT);
- L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- M. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- N. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- Q. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- R. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- S. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- T. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- U. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- V. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.
- W. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.
- X. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- Y. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

#### 1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
  - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
  - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

#### 1.6 SUBMITTALS

- A. See Division 01 – General Requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for all conduits and fittings outlined in Part 2.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
- D. Shop Drawings:
  1. Indicate proposed arrangement for conduits to be installed within or under structural concrete slabs, where permitted.
  2. Include proposed locations of roof penetrations and proposed methods for sealing.
- E. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs (where permitted), and conduits 2 inch trade size and larger.
- F. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- G. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. See Division 01 – General Requirements
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

- D. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

#### 1.9 COORDINATION

- A. See Division 01 – General Requirements
- B. Coordinate installation of outlet boxes for equipment connected under Section 260503.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.
- D. Communications contractor is responsible to fully coordinate with the site and concrete contractors and all other trades when routing conduit underslab. Routing of conduit underslab may be acceptable, provided spacing of conduits is adequate for proper backfilling of area surrounding conduits. Adequate spacing shall mean using factory made conduit spacers that allow for a minimum of 3-inches for backfilling with sand or 3 times the pipe diameter for backfilling with a structural fill. Proposed conduit routing, installation and methods and backfilling procedures shall be submitted to the Engineer for review prior to installation.

#### PART 2 PRODUCTS

- 2.1 Refer to Section 260533 – Raceway and Boxes for Electrical Systems. All Part 2 Product requirements listed in this Section shall apply to Division 27 Communications.

#### PART 3 EXECUTION

- 3.1 Refer to Section 260533 – Raceway and Boxes for Electrical Systems. All Part 3 Execution requirements listed in this Section shall apply to Division 27 Communications.

END OF SECTION

SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SECTION INCLUDES

- A. Communication system identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.

1.3 RELATED REQUIREMENTS (follow the most currently adopted amended version)

- A. See Division 01 – General Requirements
- B. Division 09 - Finishes.
- C. Section 260400 – General Conditions for Electrical Trades.
- D. Section 260553 – Identification for Electrical Trades.

1.4 REFERENCE STANDARDS (follow the most currently adopted amended version)

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
- C. NFPA 70 - National Electrical Code.
- ~~D.~~ NFPA 70E - Standard for Electrical Safety in the Workplace
- E. UL 969 - Marking and Labeling Systems.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
  - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.

2. Do not install identification products until final surface finishes and painting are complete.

#### 1.6 SUBMITTALS

- A. See Division 01- General Requirements
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Division 01 – General Requirements
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.8 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

#### 1.9 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature and humidity is lower than recommended by manufacturer.

### PART 2 PRODUCTS

- 2.1 Refer to Section 260553 – Identification for Electrical Systems. All Part 2 Product requirements listed in this Section shall also apply to Division 27 Communications.

### PART 3 EXECUTION

- 3.1 Refer to Section 260553 – Identification for Electrical Systems. All Part 3 Execution requirements listed in this Section shall also apply to Division 27 Communications, except where specified separately herein.

#### 3.2 INSTALLATION – COMMUNICATIONS SYSTEM LABELING

- A. Label Installation:

1. All labeling standards shall be confirmed with and approved by owner's IT staff prior to performing work. It is the responsibility of the contractor to coordinate with owner's staff.
  2. Labeling procedures shall meet TIA/EIA 568B Series standard and BICSI Standards and shall be pre-approved by the Owner.
  3. Permanently label, using pre-printed labels, all cables and terminations.
    - a. Patch panels and cross-connect blocks, numerically from top to bottom.
    - b. Patch panel port with work area outlet label.
    - c. Cable segments.
  4. Install label parallel to equipment lines.
  5. Use industry standard TIA/EIA and BICSI color codes.
  6. Each work station outlet jack and corresponding patch panel port shall be marked with the same, unique label.
  7. Mark the plate with standard nomenclature as required by the configuration. Mark the outlet plainly and neatly with its station identification, as indicated in above paragraph. The station identification shall also be marked inside the outlet plate on the backing plate of the outlet, and shall match the ID used at the patch panel port. Make the outlet marking using the Panduit system or equal, except for the inside marking which may be by indelible marker. Place exposed marking on outlet plates under a transparent window for protection. Label cable with permanent marker compliant with EIA/TIA 606, six (6) inches back from the termination at both ends.
- B. Wire Label Installation:
1. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
  2. Install labels at data outlets identifying patch panel and port designation as specified.
- C. Conduit Marker Installation:
1. Install conduit marker for each conduit longer than 10 feet.
  2. Conduit Marker Spacing: 20 feet on center.

END OF SECTION

SECTION 27 10 00

STRUCTURED CABLING

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section includes communications equipment room fittings, communications backbone cabling, communications horizontal cabling, work area outlets, patch cabling, connecting cords, devices and adapters.
- B. Related Sections:
  - 1. Division 01 – General Requirements
  - 2. Section 26 0400 – General Conditions for Electrical Trades
  - 3. Section 26 0526 – Grounding and Bonding
  - 4. Section 27 0529 – Hangers and Supports for Communications Systems
  - 5. Section 27 0533 – Conduit and Backboxes for Communications Systems
  - 6. Section 27 0553 – Identification for Communications Systems

1.3 REFERENCES

- A. All wire and components supplied and installed shall meet the requirements of the following and all sub-referenced documents:
  - 1. The National Electrical Code, Article 800.
  - 2. International Electrical Testing Association:
    - a. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
  - 3. National Fire Protection Association:
    - a. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
  - 4. Underwriters Laboratories, Inc.:
    - a. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and their Accessories Installed in Air-Handling Spaces.
- B. All components supplied and installed shall meet the requirements of the following standards set forth by the Telecommunications Industry Association/ Electronic Industries Alliance:
  - 1. TIA/EIA-569-C – Telecommunications Pathways and Spaces.
  - 2. TIA/EIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises.
  - 3. TIA/EIA-568-C.1 – Commercial Buildings Telecommunication Cabling Standard.
  - 4. TIA/EIA-568-C.2 – Balanced Twisted Pair Telecommunications Cabling and Components Standard.
  - 5. TIA/EIA 568-C.3 – Optical Fiber Cabling Components.

6. TIA/EIA-607-B – Generic Telecommunications Bonding and Grounding for Customer Premises.

1.4 SYSTEM DESCRIPTION

- A. Entrance Facilities: Empty raceway, boxes, etc. from utility pole to telecommunications demarcation point.
- B. Backbone pathway: Conform to TIA/EIA 569 using conduit, sleeves, J-Hooks, and other methods indicated on drawings.
- C. Horizontal pathway: Conform to TIA/EIA 569 using conduit, sleeves, J-Hooks, and other methods indicated on drawings.
- D. Backbone cabling: Inter-building and intra-building cable connections in structured cabling between entrance facilities, equipment rooms and telecommunications closets. Backbone cabling consists of the transmission media, main and intermediate cross-connects and terminations at these locations.
- E. Horizontal cabling: Cable connections in structured cabling between equipment rooms/ telecommunications closets to the work area outlet. Horizontal cabling consists of the transmission media, main and intermediate cross-connects and terminations at these locations.
- F. Structured Cabling system shall include equipment room fittings, racks, cabinets, and accessories.
- G. System shall be completely tested, certified and warrantied as specified herein.
- H. System shall include record drawings and documentation.
- I. System shall include operation and maintenance instruction manuals.

1.5 SUBMITTALS

- A. Division 01 – General Requirements.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for all products specified herein. Include detailed information on equipment construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, performance, installed accessories, and compatibility; include model number nomenclature clearly marked with all proposed features.
- C. Test Reports: Indicate procedures and results for specified field testing and inspection.
- D. Cabling Diagram: Submit for approval a complete single line cabling diagram for the building. This diagram shall include types and quantities of backbone and horizontal cabling to be installed throughout the building. Quantities to each individual work area outlet are not required to be shown in this cabling diagram; typical cable types are acceptable for this purpose. Include types of connectors at both ends of cabling. Include part numbers within this diagram.
- E. Submit for review installer qualifications as specified herein.

- F. Submit for approval a typical work area outlet panel diagram with labeling, AFTER coordination with Owner to verify labeling standard. All labels shall be coordinated with the Owner as specified herein, and in Section 27 0553.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Division 01- General Requirements.
- B. Project Record Documents: Record actual locations and sizes of pathways and outlets.
- C. Submit as-built drawings for review.
- D. Submit operations and maintenance data for review.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum THREE YEARS documented experience.
- B. UL Compliance: The communication system supplied shall be listed by Underwriters' Laboratories under the UL Standard 1459 for Telephone Appliances and Equipment. A copy of the UL listing card for the proposed system shall be included with the contractor's submittal.
- C. FCC Approval: The system shall be approved for direct interconnection to the telephone utility under Part 68 of FCC rules and regulations. Systems that are not FCC approved or that utilize intermediary devices for connection, shall not be considered. Provide FCC registration number of the system being proposed as part of the submittal process.
- D. Installer: Company specializing in installing products specified in this section with minimum three years documented experience, and with service facilities within 50 miles of project.
  - 1. Evidence of ability: Furnish training certifications. Certified training shall be industry recognized at least equal to:
    - a. Building Industry Consulting Service international, Inc (BICSI).
    - b. Ortronics Certified installer.
    - c. Hubbell Certified installer.
    - d. Leviton Certified Installer.
    - e. Siemon Cabling System Certified Installer.
- E. Provide a full time, on-site Project manager to supervise the project.
- F. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

#### 1.8 PRE-INSTALLATION MEETINGS

- A. Division 01– General Requirements.
- B. Convene minimum THREE WEEKS prior to commencing work of this section.

#### 1.9 EXTRA MATERIALS

- A. Division 01 – General Requirements.

- B. Furnish 2-48 port patch panels.
- C. Furnish 2-horizontal wire managers.
- D. Furnish five of each length and type of patch cords.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from all possible damage. Sequence deliveries to avoid delays, but minimize on-site storage.

#### 1.11 COORDINATION

- A. Coordinate the installation of cable and equipment with other construction activities and the work of other sections.
- B. Pre-installation Conference: Conduct conference at project site to comply with requirements in Division 01.
- C. Coordinate with utility company, relocation of overhead of underground lines interfering with construction.
- D. Contact utility company and coordinate installation of communication services to the building. Contractor is responsible for this coordination. Costs associated with utility company service cabling installation and startup shall be paid for by the Owner and are not part of this contract.

#### 1.12 WARRANTY

- A. Provide a warranty for minimum one (1) year against defects in material and workmanship on all components, equipment, software, systems, cabling, etc. as specified herein.
- B. Data Cabling Warranty: provide a manufacturer's data cabling twenty-five (25) year system performance warranty for the voice and data structured cabling system.
  - 1. The Contractor shall provide documented proof that he/she is authorized and certified and in good standing with the manufactures to provide this warranty.
  - 2. The contractor shall provide a written 25-year warranty from the manufacturer at substantial completion of the project.
  - 3. The warranty shall include connecting hardware products and installed cable as part of the data cabling system warranty.
  - 4. The data cabling system shall include:
    - a. Work area outlets.
    - b. Horizontal cable.
    - c. Backbone cable.
    - d. The connecting hardware in the horizontal cross-connect.
    - e. The equipment patch cord at the work area outlet.
    - f. The patch cord at the horizontal cross-connect.
  - 5. The manufacturer's warranty shall guarantee that the data cabling system shall be free from defects in materials and workmanship for the duration of the warranty.

## PART 2 PRODUCTS

### 2.1 HORIZONTAL CABLE (CATEGORY 6)

- A. Manufacturers:
  - 1. Hitachi Cable America, Inc. – Premium Enhanced UTP Cat.6
  - 2. Siemon
  - 3. Hubbell
  - 4. Mohawk/Belden
  - 5. Substitutions: Division 01 – General Requirements.
- B. All cabling shall meet or exceed Commercial Building Telecommunications Cabling Standard ANSI/TIA/EIA 568-C.2, adhering to Category 6 specifications.
- C. All horizontal cabling shall be communications plenum cable type (CMP).
- D. Cabling shall use 23AWG minimum conductors.
- E. Pulling tension: The cable pulling tension shall not exceed 25 ft/lbs as indicated in TIA/EIA-568-A.
- F. Coordinate color of horizontal cabling with the Owner.
- G. Category 6 cabling shall have the following worst-case headroom losses:
  - 1. NEXT Loss: +5 dB (Guaranteed Worst Case Headroom)
  - 2. PSNEXT Loss: +5 dB (Guaranteed Worst Case Headroom)
  - 3. ACRF: +6 dB (Guaranteed Worst Case Headroom)
  - 4. PSACRF: +6 dB (Guaranteed Worst Case Headroom)
- H. Category 6 cabling shall support 1 gigabit Ethernet.
- I. Category 6 cabling shall support the following Power-over-Ethernet protocols:
  - 1. 15W PoE (IEEE 802.3af)
  - 2. 30W PoE+ (IEEE 802.3at)
  - 3. 60W PoE++ (IEEE 802.3bt Type 3)
- J. Cable outside diameter: 0.20 inch.
- K. UTP Patch Cords: Supply patch cords which meet the following specification and are of the same TIA/EIA category rating and manufacturer as the workstation cabling:
  - 1. EIA/TIA 568-C.2 Category 6 to match patch panel type.
  - 2. 24 AWG stranded conductors
  - 3. Quantity: (48) per each Patch Panel provided for the project, plus 10% spare capacity
  - 4. Length: 50% shall be 7 feet, 50% shall be 5 feet.

### 2.2 PATCH PANELS AND TERMINATIONS FOR HORIZONTAL CABLE

- A. Manufacturers:
  - 1. Hubbell – Nextspeed
  - 2. Ortronics/Legrand
  - 3. Siemon
  - 4. Substitutions: Division 01 – General Requirements.
- B. Product Description: TIA/EIA 568B rack-mounted panels.

- C. Panels shall be ANGLED, 48 port, 2U, TIA/EIA 568B Cat. 6/6A type with integral printed circuit board, color coding, IDC type terminations, and 8-position jacks.
  - 1. Patch panels shall be either Category 6 or 6A, to match horizontal cabling type.
  - 2. Provide high density rack mounted patch panels.
  - 3. Modular port connectors that allow pre-connectorized cables to be connected to the rear of the ports are specifically prohibited. All horizontal cables shall be punched to a single point IDC-type connection on the rear of each port connector only.
  - 4. Each port shall have color-coded identification label.
- D. Quantity: Contractor is responsible for providing quantity of patch panels required to terminate all cabling indicated on drawings at associated equipment rooms. This shall include separate patch panels for different systems where this requirement is dictated on drawings (i.e. separate patch panels for data, VOIP, wireless, building systems, and other systems indicated).
  - 1. Contractor shall provide quantity of patch panels required to accommodate indicated horizontal cabling with minimum 20% spare port capacity.
- E. Provide horizontal wire management above and below each patch panel. Provide rear cable management bar with strain-relief brackets behind each patch panel.

## 2.3 WORK AREA OUTLET

- A. Manufacturers:
  - 1. Hubbell
  - 2. Ortronics/Legrand
  - 3. Siemon
  - 4. Substitutions: Division 01 – General Requirements.
- B. Product Description: Assembly consisting of faceplate and modular connectors that meet or exceed TIA/EIA-568B, Category 6 or 6A standard, to match horizontal cabling type.
- C. Each Work Area outlet shall consist of the following:
  - 1. Single or double gang thermoplastic faceplate equipped with front-loading modules with the number of voice and data jacks indicated on the Drawings and Specifications.
  - 2. Provide faceplate with clear plastic window on the top and bottom of the faceplate for labeling.
  - 3. Faceplate Color selection by Architect.
  - 4. Provide blank-off modules for all empty positions.
  - 5. Provide modular jacks that meet or exceed Category 6/6A requirements for connecting hardware as specified in TIA/EIA-568B.2 standard (type as indicated on drawings). Jacks shall be front loading, 110 style, 8-pin IDC, and RJ45 type.
  - 6. Color of each jack shall match the color of the horizontal cable. Coordinate all color requirements with the Owner and Architect.
- D. Wall phone outlets shall have stainless steel recessed wallplates.

## 2.4 ANALOG/POTS CABLING

- A. Manufacturers:
  - 1. Hitachi Cable America, Inc.
  - 2. Siemon
  - 3. Hubbell

4. Mohawk/Belden
  5. Substitutions: Division 01 – General Requirements.
- B. All horizontal cabling shall be communications plenum cable type (CMP).
- C. Analog voice cabling:
1. Backbone cabling shall be 24AWG, 25-pair cable, adhering to EIA/TIA 586-C.2 Category 5E standards.
  2. Horizontal cabling shall be 24AWG, 8P8C cable, adhering to EIA/TIA 586-C.2 Category 5E standards.
- D. Analog voice Patch Panels:
1. Provide 24 port minimum, 1U, Cat.5E type patch panel in each I.T. room for terminations of analog telephone horizontal cabling.
  2. Provide cross connect cabling between telephone company demarcation point and analog patch panel. Terminate using Amphenol jacks, or as required by patch panel type.
- E. 110-Blocks
1. Standard IDC connection type for on-premise wiring.
  2. High density wall mounted cross-connect system designed for voice and data applications.
  3. Included with designation labels and label holders.
  4. UL Listed.
  5. Provide cross connect cabling between 110-blocks and analog patch panel, where specified on plans. Terminate using Amphenol jacks, or as required by patch panel type.

## 2.5 RACK HARDWARE

- A. Manufacturers:
1. Hubbell
  2. Chatsworth
  3. Tripp-Lite
  4. Hoffman
  5. Substitutions: Division 01 – General Requirements.
- B. Equipment Racks: Free standing equipment racks shall be seven feet high, EIA 19" wide, open bay as indicated on drawings. Racks shall include the following features:
1. 2 post supports, as indicated on drawings.
  2. Universal, 10-32 threaded hole pattern on the front and rear flanges, and mounting holes on both sides of the rack for wire management.
  3. Shelves for electronic equipment rated load carrying capacity of 125% of each piece of equipment.
  4. Mounting brackets to support equipment installed in the racks.
  5. Hook and loop Velcro cable strain-relief system on rear of rack to support horizontal and backbone cable.
  6. Hook and loop Velcro cable strain-relief system on front of rack for dressing patch cables and cross-connect wiring.
  7. Bonding and grounding cables for all equipment not directly bolted to equipment rack.
  8. Grounding bus bar with terminals for #6 copper minimum bonding cables.
  9. Provide all hardware and accessories required to properly support rack from the top and bottom and assemble rack in place.
- C. Cable Management:

1. Provide horizontal cable management above and below each patch panel, and in locations shown on drawings. Horizontal management shall be sized no smaller than 1U.
2. Provide 6" rear cable management bar located behind each patch panel, and in locations shown on drawings.
3. Provide vertical cable management on both sides of each rack, and in locations shown on drawings. Vertical management shall be sized no smaller than 6". When mounted between racks, size no smaller than 12".

## 2.6 BACKBOARDS

- A. Material: Class "A" fire retardant plywood.
- B. Size: 3/4" thick. Width and Height as indicated on drawings.
- C. Provide backboards for all utility demarcation equipment.
- D. Paint with two(2) coats of grey paint.

## 2.7 SERVICE ENTRANCE TEXTILE INNERDUCT

- A. Manufacturers:
  1. Provide products offered by MaxCell Group/TVC Communications 600 Plum Creek Dr. Wadsworth, OH. 44281 1-888-387-3828
  2. Substitutions: Division 01 – General Requirements.
- B. Contractor shall provide, in at least one(1) of the building's telecommunications service entrance conduits, flexible, textile innerduct to allow for future communication system upgrades and separation of cabling within the conduit.
- C. Product Description: Standard Outdoor Textile Innerduct: Micro (33mm), 4-inch single or multi-cell polyester/nylon textile innerduct containing 1250lb polyester flat woven pull tape. Provide MaxCell 4" 3-cell or approved equal.
- D. Fittings:
  1. Conduit Plugs: Compression-type conduit plugs with locking nuts for sealing and securing one or more textile innerducts within a 4-inch inside diameter conduit, e.g.: 4-inch plug with nine holes for cables in a 3 pack (9-cell) configuration
  2. Termination Bags: Inflation-type bags for sealing and securing around one or more textile innerducts and cables within 2-inch outside diameter or larger conduit.
- E. Material: White Polyester and Nylon resin polymer.

## 2.8 LIGHTNING PROTECTION FOR COMMUNICATIONS CABLING

- A. Manufacturers:
  1. Circa
  2. Citel
  3. Times Protect
  4. Substitutions: See Division 1 – Product Requirements.
- B. Provide surge/lightning protection for all exterior copper telecommunications cabling (both aerial and underground). This shall include, but not be limited to the following:
  1. Service entrance cabling

2. Cabling between buildings
  3. Cabling for paging, clock and other building systems
  4. Data/Voice horizontal cabling
  5. CATV Cabling
- C. Provide surge/lightning protection for all copper backbone cabling between the service entrance room to each equipment room.
- D. For service entrance cabling and telecommunications backbone cabling, provide Circa model 1880ECA1-XXX or equal (sized appropriately), to interface directly with rack-mounted patch panels and distribution.
- E. For horizontal data/voice cabling to exterior systems or between buildings, provide Citel model #E280 or equal, type and quantity as required by the system being protected.
- F. For CATV cabling to exterior systems or between buildings, provide Citel P8AX series in-line surge arrestor or equal. Provide surge arrestor at each end of coaxial line.
- G. For POE/ethernet cabling to exterior systems or between buildings, provide Citel model MJ8-POE-A or equal, type and quantity as required by the system being protected.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Rated Stairs: Penetrations into stairs are NOT permitted except for items serving that stair.
- B. Wiring Method:
1. Install all required telecommunications conduits, sleeves, and back boxes. Conduits, sleeves and boxes shall be installed in accordance with Section 270533.
  2. Install cables in raceways, conduits and interstitial spaces above suspended ceilings.
  3. Conceal wiring except in unfinished spaces.
  4. Wire shall not be subjected to pulling tensions greater the maximum specified by the manufacturer
  5. Wire bend radius shall not be less than the manufacturer's minimum of one (1) inch.
  6. Support cables that are not in raceway or conduit at intervals no greater than 60 inches with supports designed for high-speed twisted pair wire ("J" hooks).
- C. Horizontal Cables:
1. Mount new station jacks on the specified plate, flush or surface mounted, as construction requires.
  2. At the station end, terminate 4-pair UTP cables on 8-pin modular jacks according to TIA/EIA 568B terminating specifications.
  3. At the telecom room, terminate all 4-pair UTP cables (voice & data) onto panel mounted 8-pin modular connectors that meet the TIA/EIA 568B specification. Provide sufficient patch jacks (ports) at each telecom closet to terminate the cables from all of the stations served by that closet. Mark the voice and data patch terminating jacks with its associated station identification in ascending sequential order. Mark patch panel using the Panduit system or equal. Match the patch panels into the supplied equipment racks.

4. Analog Line (Emergency Line) Connection:
    - a. Coordinate with Telephone provider. Telephone provider shall terminate phone service at DEMARC. Contractor shall extend, punch down and make final connections to the specific locations listed below for complete service.
    - b. Provide patch panels as indicated in above PART 2. Terminate all cables within these panels.
    - c. The Contractor is responsible for establishing an analog metallic connection to each analog line, locations shown on drawings.
  5. Provide coaxial cabling from work stations back to cable company demarcation equipment.
  6. Provide 9" of slack on outlet boxes behind each faceplate.
- D. Supports:
1. Cabling shall be supported via cable trays where indicated in drawings. Cabling between cable tray and work station shall be supported via J-Hooks as indicated in drawings. Where cable tray is not indicated on drawings, cabling shall be supported via J-Hooks along entire run from telecom room to work area outlet.
  2. Refer to Section 27 0529 – Hangers and Supports for Communications Systems for J-hook product and installation requirements.
- E. Grounding of telecommunications equipment and cabling:
1. Ground all equipment in accordance with Section 26 0526 – Grounding and Bonding.
  2. Provide grounding, surge protection and lightning protection of telecommunications system in accordance with latest version of Grounding, Bonding and Electrical Protection chapter of the BICSI TDM Manual, TIA/EIA 607, and NFPA 70.
  3. Conform to all telecommunications grounding and bonding details and riser diagrams included within the drawings.
- F. Wall phone boxes shall be spaced 10" away from any sidewall, corner, doorjamb or adjacent box.

### 3.2 TESTING, HORIZONTAL CABLING

- A. Horizontal cabling testing shall be conducted from the jack at the outlet in the Work Area to the Patch Panel on which the cables are terminated.
- B. Baseline accuracy of the test equipment must exceed TIA Level III, as indicated by independent laboratory testing. Test adapter cable must be approved by the manufacturer of the test equipment.
- C. All horizontal cables must be tested with a Level 3 Fluke DTX Networks Cable Tester.
- D. Testing of the Permanent Link shall be performed. However, contractor shall warrant performance based on channel performance and provide patch cords that meet channel performance criteria. All cabling not tested strictly in accordance with these procedures shall be retested at no cost to the Owner.

- E. Horizontal station cables shall be free of shorts within the pairs, and be verified for continuity, pair validity, and polarity, and Wire Map (Conductor Position on the Modular Jack). Any defective, split or miss-positioned pairs must be identified and corrected.
- F. Testing of the Cabling Systems rated at TIA Category 6/6A and above shall be performed to confirm proper functioning and performance.
- G. Testing of the Transmission Performance of station cables (Category 6/6A) shall include:
  - 1. Length
  - 2. Attenuation
  - 3. Pair to Pair NEXT
  - 4. ACR
  - 5. PSNEXT Loss
  - 6. Return Loss
  - 7. Pair to Pair ELFEXT Loss (Equal Level Far End Cross-Talk)
  - 8. PSEFEXT Loss
  - 9. Propagation Delay
  - 10. Delay Skew
  - 11. Return Loss
- H. The maximum length of horizontal cable shall not exceed 90 meters, which allows 10 meters for equipment and patch cables.
- I. Cables shall be tested to the maximum frequency defined by the EIA/TIA 568B standards covering that performance category. Test records shall verify a "PASS" on each cable and display the specified parameters – comparing test values with standards based "templates" integral to the unit.
- J. Any "Pass\*" or "Warning" test results shall be considered a "FAIL" for the channel or permanent link under test. In order to achieve an overall "Pass Condition", the test result for each individual test parameter shall be "PASS".
- K. All data shall indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1MHz to the highest relevant frequency, using a swept frequency interval consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations. And in both directions when required by the appropriate standards.

### 3.3 DOCUMENTATION

- A. At the completion of the project and prior to system acceptance provide the following documentation:
  - 1. As-built floor plans that show the final location and identification of the telecom outlets. Submit the floor plans in printed form and as AutoCAD 2010 files (Original AutoCAD files will be made available).
  - 2. Test results for each strand of fiber optic cable installed. This should be supplied in a page per strand printed format and in machine-readable (computer file) format. If the machine-readable file requires special software for reading, a single-user version of that software shall be provided as well.
  - 3. Test results for each pair of copper riser cabling installed and the installed cable length.
  - 4. Test results for each UTP station cable installed. This should be supplied in a page per cable printed format and in machine-readable (computer file) format. If the machine-readable file requires special software for reading, a single-user version of that software will be provided as well.

5. Test results for each coaxial riser and horizontal cable installed. Documentation indicating successful testing and length for each cable shall be bound and provided by the vendor.
6. Cross connection documentation for the voice station cable (cut sheets) which detail the station number, telecom room, and riser pair number for each installed cross connection.

END OF SECTION

SECTION 27 41 00

AUDIO-VIDEO SYSTEMS

(Part of Filed Sub-Bid Section 26 00 01- Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. This section covers the procurement, construction, installation, and training of the installed or “local” audio-video systems within the project. The objective is to provide fully professional audio-video Systems, completely installed on premises and acceptance tested for use. The intent of this section is to specify the required equipment, methods, and scope of services required to provide a premium professionally installed, performance tested sound system. This section in conjunction with the attached project details defines the technical, functional, and performance requirements for the specified Audio-Video Systems.
- B. Project Audio-Video Systems are located in the following areas:
1. Function Hall
  2. Conference Room
- C. Section Includes:
1. Video Switching Equipment.
  2. Audio Signal Processors and mixing equipment.
  3. Audiovisual Control Equipment.
  4. Amplifiers and loudspeakers.
  5. Microphones, cameras, video displays and other input and output devices.
  6. Extenders and HDBASE-T equipment.
  7. Cabling, connectors, patch panels, keystones, patch cords, mounting equipment, racks, and similar equipment for a complete and operational system.
- D. Related Sections:
1. Division 01 – General Requirements
  2. Section 26 0400 – General Conditions for Electrical Trades.
  3. Section 27 0529 – Hangers and Supports for Communications Systems.
  4. Section 27 0533 – Raceway and Boxes for Communications Systems.
  5. Section 27 0553 – Identification for Communications Systems.
  6. Section 27 1000 – Structured Cabling (for Ethernet cable requirements).

1.3 REFERENCES

- A. Work included in these specifications is to be performed within the parameters of the following standards:
1. AES (Audio Engineering Society)
  2. ASTM (American Society of Tests and Measurements).

3. IEEE (Institute of Electrical and Electronic Engineers)
4. NAB (National Association of Broadcasters)
5. NEC (National Electrical Code)

#### 1.4 SYSTEM DESCRIPTION

- A. This Specification establishes the requirements necessary to achieve the intended performance and function of the Audio-Video System(s) described herein. Therefore, all materials and labor that are specified are necessary to meet these requirements. It includes materials and labor required to provide a complete and operable system(s) as specified herein and shown with the Audio-Video Systems drawings.
- B. It is understood and agreed by the project contractor that the systems described herein shall be completed in every detail necessary to supply a complete, working system(s) implemented in a professional manner.
- C. This text as well as the provided drawings are only necessary to define the design intent and anticipated performance requirements. Equipment not discreetly mentioned or outlined in these documents shall be provided without claim for additional payment.
- D. Drawings included with this document shall be considered part of this specification. The Contractor will provide complete and operating system(s) including all labor and materials for all assemblies and sub-assemblies either specified or implied within this project document.
  1. Equipment function and features are to be provided by the Contractor. Where a specific item is listed by manufacturer's name and product number it identifies a minimum requirement for performance parameters and functionally defined by the product. This is not only limited to the device specified but also by the manufacturer's warranties.
  2. If a Contractor intends to provide goods other than those specified, such as "an equivalent" device it must clearly be documented within the bid response. Proposed "equivalent" items must include a written certification from the manufacturer of the replaced item stating the equivalency of each item in regard to features, function, performance, and future system capabilities.
  3. A contractor wishing to substitute items with an equivalent product must be willing to demonstrate the equivalency of said item to the owner and owner's representative at the contractor's expense. This proof of equivalency, in addition to the manufacturer's letter may include the following.
    - a. "On-Site" side by side demonstration of both the specified unit and the proposed equivalent item.
    - b. Independent laboratory test report. This is to include spreadsheet comparison of all critical distortion, frequency response, dynamic range, and power requirements. All tests based upon current AES standards.
    - c. Equipment costs for proposed substitution items shall be listed showing the owner or owner's representative a cost savings incurred with the use of said proposed item.
    - d. Contactor costs incurred, travel expenses, and other related costs shall be incurred by the contractor.
    - e. Any professional services, service fees of engineers, consultants, or architects as a result of time being expended during this review, charged to the owner ,shall be reimbursed to the owner by the contractor and/or his sub-contractor.
- E. Provide all audiovisual patch cables to establish complete systems to the end-user level.
- F. The audiovisual cable raceway systems consist of the following:

1. The Metallic Conduit System is a network of empty conduits into which the Audiovisual Contractor shall install the cables for the audiovisual system.
- G. Unless specifically called out otherwise, all audiovisual system wiring listed in the audiovisual schedule of terminations shall be run in metallic conduit.

#### 1.5 SUBMITTALS:

- A. Submit under provisions of Division 01.
- B. Submittals shall include a complete "Bill of Material" by each sound system area. This shall include all components required to complete an operational system. Each item shall include the following:
  1. Quantity of device(s)
  2. Manufacturer's current model number
  3. Manufacturer's name
  4. Item description
- C. CAD produced drawings shall be included with package. These shall include, but not be limited to, the following:
  1. All systems showing general wiring.
  2. All System(s) signal path, as a one line riser.
  3. Any and all custom manufactured panel assemblies.
  4. Equipment Cabinet Risers
- D. List a minimum of four completed project references similar to the scope of this project. Include project name, location, and contact names of references.
- E. Provide a statement from the major manufactures showing the sound contractor is an authorized representative of that product. This is to insure products are current, recall notices are acknowledged, and correct programming/installation methods are employed as recommended by the manufacture.
- F. Include a list of testing equipment owned by the Audio-Video contractor.
- G. Warranty Information: The vendor is required to submit, with this bid, specifications describing the standard warranty for all proposed cable and hardware.
- H. The Electrical Contractor shall submit a conduit riser diagram for all audiovisual system wiring.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Division 01– General Requirements.
- B. Project Record Documents: Record actual locations of all input and output stations for display devices.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum THREE YEARS documented experience.
- B. Installer: Company specializing in installing products specified in this section with minimum three years documented experience.

- C. Provide a full time, on-site Project manager to supervise the project.
- D. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

#### 1.8 PRE-INSTALLATION MEETINGS

- A. A minimum of one contractor meeting will be required with the owner or owner's representative to review the scope of project. The intent of this is to review submittals, proposed construction, proposed installation, and to coordinate sound system(s) installation with other trades.

#### 1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and product in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from all possible damage. Sequence deliveries to avoid delays, but minimize on-site storage.

#### 1.10 COORDINATION

- A. Coordinate the installation of cable and equipment with other construction activities and the work of other sections.

#### 1.11 WARRANTY

- A. Contractor's Warranty: Warranty the installation to be free of defect for a period of two (2) years.
- B. Equipment Warranty: Each piece of equipment shall carry a two(2) year manufacturer's warranty.

### PART 2 PRODUCTS

#### 2.1 GENERAL

- A. Manufactured Products:
  - 1. All items provided by contractor shall be current models and "brand new" in manufacture.
  - 2. Demonstration models, tested equipment, or previously used items will not be accepted.
  - 3. Any item that is obsolete shall be identified to owner or owner's representative.
  - 4. Owner or owner's representative reserves the right to accept or decline any proposed equipment substitution.
- B. Custom Manufactured Items:
  - 1. All custom fabricated items are to be submitted in CAD format with submittal package and subject to the approval of the owner or owner's representative. Contractor is responsible for incurring costs if samples of fabricated panels are requested. Custom made panels are to be new in origin and made to order for this specific project.

## 2.2 AUDIO-VIDEO SYSTEM EQUIPMENT

- A. Basis of design equipment is listed on sound system riser diagrams, on the drawings.
- B. Acceptable manufacturers:
- |   |                                      |
|---|--------------------------------------|
| 1. Video Switchers:                                   | Extron, Crestron, AMX                |
| 2. Audio Signal Processors:                           | Extron, Crestron, AMX                |
| 3. Audio Amplifiers:                                  | Extron, Crestron, Bose               |
| 4. Loudspeakers:                                      | Extron, Crestron, Bose               |
| 5. Audio-Video Control/Touchscreen:                   | Extron, Crestron, AMX                |
| 6. Cameras:   | PTZoptics, Poly, Legrand             |
| 7. Displays:  | NEC, Samsung, LG                     |
| 8. Extenders/HDBASET:                                 | Extron, Crestron, Hubbell            |
| 9. Network Switches:                                  | Netgear, Cisco, HP *see below*       |
| 10. Microphones:                                      | Shure, Sennheiser, Sony              |
| 11. Rack Equip:                                       | Middle Atlantic, AtlasIED, Hoffman   |
| 12. Power Equip:                                      | Middle Atlantic, AtlasIED, TrippLite |
| 13. ADA Equip:  | Listen Audio                         |
| 14. Substitutions: Division 01 – Product Requirements |                                      |
- C. Network switches shall be approved by Audinate for use with Digital Audio Networking Through Ethernet (DANTE). All network switches shall be MANAGED, POE+ type.
- D. Custom panels shall be engineered and manufactured by ProCo/Rapco, or equal.
- E. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees. Said modifications shall include, but not be limited to, changes to 120VAC power outlets, conduits, backboxes, data cabling, infrastructure and other required pathways.

## 2.3 AUDIOVISUAL CABLING

- A. Manufacturers:
1. C2G
  2. Extron
  3. FSR
  4. Belden
  5. Crestron
- B. Passive HDMI cable for in-wall applications:
1. Basis of Design model numbers:
    - a. Legrand/C2G 50612: 15 ft High Speed HDMI Cable.
  2. Provide this system where indicated on the drawings, and where HDMI in-wall cabling is 15 feet or less in length.
  3. Passive HDMI cables shall not require power for transmission and shall support the specification listed herein without a power supply.
  4. Passive HDMI cables shall be provided with a compatible pass-through HDMI 2.0 connector/keystone mounted in a faceplate on both the source and display ends of the run. The connector shall be by the same manufacturer as the cable and shall be approved by the cable manufacturer to support the specifications listed herein, with minimal signal degradation.
  5. Active HDMI cables shall meet or exceed the following specifications:
    - a. CL2-rated jacket for in-wall installations.

- b. Supports resolutions up to 4096x2160 at 60 Hz 4:4:4 (Full 4K), including 3D and dual video streams (Dual View).
  - c. Data speeds up to 18.0Gbps.
  - d. Supports full HD Blu-ray and HD DVD video.
  - e. Supports 8, 10, 12, and 16 bit per channel deep color.
  - f. Supports up to 32 audio channels and a 1536kHz audio sampling rate.
  - g. Supports DTS-HD Master Audio™, Dolby TrueHD™, DTS, Dolby AC3 & DSD Audio.
  - h. Supports extended CEC (Consumer Electronics Control) commands and functions, HDMI Ethernet Channel (100 Mbits/s) and ARC (Audio Return Channel).
  - i. Type "A" male HDMI pre-terminated connectors on both ends.
- C. Active/powerd HDMI cable for in-wall applications:
- 1. Basis of Design model numbers:
    - a. Legrand C2G 41413: 25 ft Active High Speed HDMI Cable.
    - b. Legrand C2G 41414: 35 ft Active High Speed HDMI Cable.
  - 2. Provide this system where indicated on the drawings, and where HDMI in-wall cabling exceeds 15 feet in length.
  - 3. Active HDMI cables shall not require any external power connectors or dongles.
  - 4. Active HDMI cables shall receive power by plugging directly into the source and display devices. Do not provide keystones, female connectors or patch cords for connectivity. Provide rubber grommet pass through devices within faceplates on both the source and display end for direct routing of HDMI cable.
  - 5. Active HDMI cables shall meet or exceed the following specifications:
    - a. CL3-rated jacket for in-wall installations.
    - b. Supports resolutions up to 4096x2160 at 60 Hz 4:4:4 (Full 4K), including 3D and dual video streams (Dual View).
    - c. Data speeds up to 18.0Gbps.
    - d. Supports full HD Blu-ray and HD DVD video.
    - e. Supports 8, 10, 12, and 16 bit per channel deep color.
    - f. Supports up to 32 audio channels and a 1536kHz audio sampling rate.
    - g. Supports DTS-HD Master Audio™, Dolby TrueHD™, DTS, Dolby AC3 & DSD Audio.
    - h. Supports extended CEC (Consumer Electronics Control) commands and functions, HDMI Ethernet Channel (100 Mbits/s) and ARC (Audio Return Channel).
    - i. Type "A" male HDMI pre-terminated connectors on both ends.
- D. USB cables shall meet or exceed the following specifications:
- 1. Version "3.0".
  - 2. A-A or A-B type, as indicated on drawings.
  - 3. 24 / 28 AWG copper conductors.
  - 4. Up to 4.8 Gbps bandwidth.
- E. Stereo audio cables shall meet or exceed the following specifications:
- 1. 3.5mm type
  - 2. Shielded
  - 3. Tip-ring-sleeve
  - 4. Fully molded connector with strain relief
- F. VGA cables shall meet or exceed the following specifications:
- 1. Supports up to 2048x1536 resolution.
  - 2. 15-pin type.
  - 3. 26 / 28 AWG copper conductors.
  - 4. Voltage Rating: 30V.

- 5. Nominal Impedance: 75 ohm, +/- 5 ohm.
- G. All cables shall be factory-supplied with connectors as indicated on drawings.
- H. All cables shall be rated for in-wall applications.

## 2.4 AUDIOVISUAL CONNECTORS

- A. Connectors from the following manufacturers shall be considered acceptable. Install connectors appropriate for the installed cable and equipment interface. Use appropriate tooling as specified by the connector manufacture to install the connectors.
  - 1. Hubbell
  - 2. Tripp-Lite
  - 3. Extron
  - 4. FSR
- B. HDMI connectors:
  - 1. Description: HDMI 2.0 feed-through keystone.
  - 2. Approved and recommended for use with the associated HDMI cable (passive or active), as noted in above paragraph.
- C. VGA connectors:
  - 1. Description: 15-pin screw terminal, suitable VGA, SVGA, XGA and SXGA resolution.
- D. USB connectors:
  - 1. Description: USB 3.0 A-A feed through keystone.
- E. Stereo audio (3.5mm) connectors:
  - 1. Description: 3.5mm screw terminal.
- F. Provide all necessary mounting accessories, faceplates and keystones for a complete installation.
- G. Blank spaces in audiovisual faceplates shall be filled with blank connector components, Hubbell iStation SFB10 or equal.

## 2.5 EXTENDERS AND HDBASE-T EQUIPMENT

- A. Manufacturers:
  - 1. Extron
  - 2. Crestron
  - 3. Hubbell
- B. System description: Audio-video equipment for the purpose of extending multiple signals over a single Cat.X cable.
- C. Refer to drawings for model numbers and additional product requirements.
- D. At a minimum, all extenders shall meet the following general specifications:
  - 1. Support 4K and 1080p video signal.
  - 2. Support USB 3.0 capability.
  - 3. Support stereo audio signal.

- E. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees. Said modifications shall include, but not be limited to, changes to 120VAC power outlets, conduits, backboxes, data cabling, infrastructure and other required pathways.

## PART 3 EXECUTION

### 3.1 INSTALLATION – GENERAL

- A. Prior to installation, the Electrical Contractor shall submit a riser diagram for all audiovisual system conduit.
- B. No installation work shall proceed until the conduit riser has been approved, in writing, by the Electrical Engineer.
- C. All lines installed in conduits shall be splice free. Cabling shall be free from installation damage.
- D. All connector wiring shall be by rosin core solder joints. No push on type connectors shall be accepted.
- E. All cables to be numbered and identified in “As Built Documents”. Provide permanent cable identification.
- F. Project shall be adequately staffed at all times. Coordination with other trades and cooperation is mandatory.

### 3.2 INSTALLATION – EQUIPMENT

- A. All material and equipment to be new and unused.
- B. Provide adequate ventilation for all active electronic equipment.
- C. All equipment shall be installed without dents, scratches, free of marks and blemishes.
- D. The contractor is responsible for all tuning, programming, setup and configuration of all audiovisual systems.
- E. Monitors/Screens: Supply screens with tilting wall mounts or single point ceiling mounts with provision for mounting a Set Top Box If connected to the Digital Streaming Media system. Mount the units at the locations indicated on the Technology Drawings. Connect the units to AC power and the Local Area Network or CATV distribution as required. Confirm full operation.

### 3.3 INSTALLATION - WIRE GROUPS IN CONDUIT

- A. All audiovisual wiring shall be installed in conduit.
- B. Minimum conduit diameters and diagrammatic routing of audiovisual conduits are indicated on drawings.

- C. The actual diameter and path of each conduit run shall be determined by the Electrical Contractor in accordance with field conditions.
- D. Should the Electrical Contractor choose to combine cable runs from individual terminations into a common conduit, then they must conform to the wire grouping, conduit fill, and conduit separation requirements listed in this Section.
- E. To prepare the required conduit riser diagram, the Electrical Contractor must group cables by wiring type; determine the total number of cables in each conduit run; determine the diameter of each conduit run; determine the actual routing of each conduit run.
- F. Refer to Paragraph 3.4 of this Section for wiring group and conduit separation requirements.
- G. Refer to Table 5 at the end of this Section for audiovisual cable specifications and conduit capacities.

### 3.4 INSTALLATION - CONDUIT SEPARATION

- A. Audiovisual system wiring is divided into separate groups according to their nominal voltage levels. These wiring groups must never be intermixed within a given conduit run. See Table 2 at the end of this Section for wire type information.
- B. Conduits carrying audiovisual wiring must maintain a minimum separation from conduits carrying other types of audiovisual wiring. When necessary, ninety degree crossings in close proximity are acceptable. See Table 3 at the end of this Section for audiovisual conduit separation requirements.
- C. Conduits carrying audiovisual wiring must maintain a minimum separation from conduits carrying other types of electrical wiring. Unusually heavy current demands in; or long parallel runs with; electrical services may dictate greater separations to avoid interference with the audiovisual system. See Table 4 at the end of this Section for electrical conduit separation requirements.

### 3.5 INSTALLATION - METALLIC CONDUIT SYSTEM

- A. The metallic conduit system is specified by information called out in the large-format audiovisual system drawings:
  - 1. The location drawings indicate the position of each audiovisual device and the method of mounting each device.
    - a. The schedule of terminations lists each audiovisual device; indicates the quantities, types, and groupings of all cables connected to each device; and lists the destination for all cables exiting each device.
- B. Refer to Table 5 at the end of this Section for audio cable specifications and conduit sizing requirements.
- C. In most cases, each run of this conduit system shall be bonded to the audio termination back boxes which are provided by the Audiovisual Contractor. The only exception is conduit which is routed to the audio equipment racks. Conduit runs entering or exiting the audio equipment racks shall be electrically isolated from the racks. PVC or other non-conductive fittings shall be used to isolate the conduit from the audiovisual equipment racks.

- D. Provide all empty conduits with pull lines.

3.6 INSTALLATION - CABLE SLEEVES

- A. Install per architectural detail drawings with threaded cap at each end of sleeve. These caps shall be lubricated for easy removal and held captive by a chain.

3.7 TESTING

- A. Each cable and equipment manufacturer shall factory-test their respective products being installed on this project and provide test reports at time of delivery. Provide separate, respective test reports, indicating that products meet or exceed the latest applicable TIA/EIA Standards and technical bulletins.
- B. All other products relative to this specification shall be tested to their respective industry's strictest standards.
- C. Each manufacturer shall factory-test their respective cable or equipment provided to this project at several lower frequency levels, including the minimum and maximum frequency level indicated herein. The test reports shall indicate test results for at least five equal incremental frequency levels, including the maximum required.
- D. Presentation Systems: Verify the functionality of each installed system. Verify that connectors are properly installed and where appropriate, screwed down. Cable shall be neatly dressed and tied back. Tag cable with permanent markers indicating the function of each cable. Adjust and balance audio systems to provide a minimum of 85db/spl at the average listening position. System testing shall be coordinated with the Owner's representative.

3.8 DOCUMENTATION

- A. Provide copies of all manuals and two (2) sets of as-built documents, in hard copy and electronic format. As-built documentation shall include location and types of hardware provided and installed as well as the interconnection of each device.

3.9 TRAINING:

- A. The Owner may assign personnel to participate with the contractor during installation. Without delaying the work, familiarize the Owner's personnel with the installation, equipment, and maintenance.
- B. Provide training to personnel selected by the Owner on operation and basic maintenance of all systems and equipment.
- C. Duration of Training: Eight(8) Hours.

3.10 REFERENCE TABLES  
TABLE 1 - PROJECT WORK SCOPE

ITEMS TO BE PROVIDED AND INSTALLED	Electrical Contractor		Audiovisual Contractor	
	Provides	Installs	Provides	Installs
Audiovisual Equipment Racks and Devices			x	x

1. Metallic Conduit between Audiovisual Devices and Audiovisual Equipment Racks	x	x◇		
2. Conduit Insulation Bushings between Metallic Conduit and Audiovisual Equipment Racks	x	x◇		
3. Audiovisual Equipment Rack Cabling			x	x
4. Audiovisual Equipment Rack Terminations				x
5. Audiovisual Device Back Boxes and Floor Boxes		x◇	x	
6. Audiovisual Device Metallic Conduit	x	x◇		
7. Audiovisual Device Cabling			x	x
8. Audiovisual Device Termination				x
Audiovisual Cable Sleeves	x	x		
Audiovisual Pull Boxes	x	x		
Conduit Riser Diagram	x			

◇ Installation criteria to be provided by Audiovisual Contractor

**TABLE 2 - AUDIOVISUAL WIRING TYPES**

Audiovisual system wiring is divided into wiring groups according to their nominal voltage levels:

	Wiring Type
Group A	Microphones and other sensitive wiring (0 mV to 100 mV)
Group B	Line level wiring (100 mV to 10 V)
Group C	Loudspeaker and control wiring (10 V to 70 V)
Group D	Telephone, video, control and digital circuits (including Category Structured cabling for data)
Group E	Fiber optic cable

Note: These wiring groups must never be intermixed within a given conduit run!

**TABLE 3 - AUDIO CONDUIT SEPARATION**

Minimum conduit separation between conduits carrying wiring of different audiovisual groups is as follows:

	Group A	Group B	Group C	Group D	Group E
Group A	adjacent	6"	12"	12"	adjacent
Group B	-	adjacent	12"	6"	adjacent
Group C	-	-	adjacent	6"	adjacent
Group D	-	-	-	adjacent	adjacent
Group E	-	-	-	-	adjacent

Note: Ninety degree crossings in close proximity are acceptable.

TABLE 4 - ELECTRICAL CONDUIT SEPARATION

Minimum conduit separation between conduits carrying audiovisual wiring and other electrical service conduit is as follows:

	Group A	Group B	Group C	Group D	Group E
Dimmer controlled lighting	24"	12"	6"	12"	adjacent
SCR controlled services	24"	12"	6"	12"	adjacent
220/440VAC circuits	6"	6"	adjacent	adjacent	adjacent
All other services	6"	6"	adjacent	adjacent	adjacent

Note: Heavy current demands in or long parallel runs with the above services may dictate greater separations to avoid interference with the audiovisual systems.

TABLE 5 - CONDUIT SIZING FOR AUDIO CABLES

Audio (dimensions in inches)				Cable Maximum number of audio cables allowed in each conduit (Based on 40% fill of EMT)							
Mfr	Type	OD	Area	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	
Belden	1351A	0.290	0.066	3	5	9	12	20	35	53	
Belden	1502R	0.250	0.049	4	7	12	17	27	48	72	
Belden	1694A	0.274	0.059	4	6	10	14	23	40	60	
Belden	1696A	0.234	0.043	5	8	14	19	31	54	82	
Belden	1700A	0.200	0.031	7	11	19	26	43	75	113	
Belden	2412	0.220	0.038	5	9	15	21	35	61	93	
Belden	7710A	0.770	0.466	0	1	1	2	3	5	8	
Belden	7712A	0.970	0.739	0	0	1	1	2	3	5	
Belden	7810A	0.405	0.129	2	3	5	6	10	18	27	
Belden	8240	0.193	0.029	7	12	20	28	46	80	121	
Belden	8281	0.305	0.073	3	5	8	11	18	32	48	
Belden	8444	0.185	0.027	8	13	22	30	50	87	132	
Belden	8451	0.138	0.015	14	23	40	54	90	157	237	
Belden	8465	0.282	0.062	3	6	10	13	21	38	57	
Belden	8467	0.314	0.077	3	4	8	11	17	30	46	
Belden	8471	0.274	0.059	4	6	10	14	23	40	60	
Belden	8473	0.340	0.091	2	4	7	9	15	26	39	
Belden	8477	0.386	0.117	2	3	5	7	11	20	30	
Belden	8489	0.257	0.052	4	7	12	16	26	45	68	
Belden	8620	0.376	0.111	2	3	5	7	12	21	32	
Belden	8734	0.194	0.030	7	12	20	28	45	79	120	
Belden	8760	0.222	0.039	6	9	15	21	35	61	91	
Belden	9451	0.135	0.014	15	24	42	57	94	164	247	
Belden	9460	0.230	0.042	5	8	14	20	32	56	85	
Belden	9831	0.330	0.086	2	4	7	9	15	27	41	
Belden	9844	0.390	0.119	2	3	5	7	11	20	30	
Belden	9941	0.230	0.042	5	8	14	20	32	56	85	
Crestron	DM-CBL-NP	0.580	0.264	0	1	2	3	4	8	13	
Crestron	DM-CBL-8G-NP	0.244	0.047	4	7	12	17	28	50	75	

Trade	#08 THHN	0.216	0.037	6	9	16	22	37	64	97
Trade	#10 THHN	0.164	0.021	10	16	28	39	64	111	168
Trade	#12 THHN	0.130	0.013	16	26	45	61	101	177	267
Trade	#14 THHN	0.111	0.010	22	36	62	84	139	242	366

Note: Minimum conduit size allowed for audio cables is 3/4 inch.

**END OF SECTION**

SECTION 28 3100

FIRE DETECTION AND ALARM

(Part of Filed Sub-Bid Section 260001 – Electrical Work)

PART 1 GENERAL

1.1 GENERAL PROVISIONS – FILED SUB-BID REQUIRED

- A. Work of this Section requires Filed Sub-Bids and is governed by the provisions of the Massachusetts General Laws (MGL), Public Bidding Law Chapter 149A Section 8, Chapter 149 Section 44F, and applicable Section of the MGL, Public Contract Law Chapter 30 as amended.

1.2 SUMMARY

- A. Section includes fire alarm control panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, and auxiliary fire alarm equipment and power and signal wire and cable.
- B. Related Sections:
  - 1. Section 26 05 19 – Building Wire and Cable
  - 2. Section 26 05 26 – Grounding and Bonding
  - 3. Section 26 05 29 – Hangers and Supports
  - 4. Section 26 05 53 – Raceway and Boxes
  - 5. Section 26 05 33 – Identification for Electrical Systems, for labeling and identification requirements.

1.3 REFERENCES

- A. International Building Code.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; current edition.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 72 - National Fire Alarm and Signaling Code

1.4 SYSTEM DESCRIPTION

- A. 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. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.
- B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for Local Protected Premises Signaling Systems except as modified and supplemented by this

specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

1. The Secondary Power Source of the fire alarm control panel will be capable of providing at least 24 hours of backup power with the ability to sustain 5 minutes in alarm at the end of the backup period.

C. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on Class B circuits, unless otherwise indicated on drawings.
2. Notification Appliance Circuits (NAC) shall be wired Class B as part of an addressable device connected by the SLC Circuit, unless otherwise indicated on drawings.
3. All circuits shall be power-limited, per UL864 9<sup>th</sup> edition requirements.
4. A single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm when wire NFPA Style 6/7.
5. Alarm signals arriving at the main FACP shall not be lost following a primary power failure or outage of any kind until the alarm signal is processed and recorded.

D. Alarm Sequence of Operation: Actuation of initiating device causes the following system operations:

1. Local fire alarm signaling devices sound and display with signal.
2. Zone-coded signal transmits to central station.
3. Location of alarm zone indicates on fire alarm control panel and on remote annunciator panel.
4. Signal transmits to building mechanical controls, shutting down fans and operating dampers.
5. Refer to drawings for additional actions required to occur during alarm state.

E. Trouble Sequence of Operation: System or circuit trouble causes the following system operations:

1. Visual and audible trouble alarm indicates by zone at fire alarm control panel.
2. Visual and audible trouble alarm indicates at remote annunciator panel.
3. Trouble signal transmits to municipal connection.

## 1.5 SUBMITTALS

- A. Division 01: Submittal procedures.
- B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection; indicate annunciator layout, and design calculations.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements.
- D. Test Reports: Indicate procedures and results for specified field testing and inspection.
- E. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

- G. Submit complete fire alarm battery calculations, taking all devices within building into account.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Division 01: Closeout procedures.
- B. Project Record Documents: Record actual locations of fire alarm equipment.
- C. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

#### 1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.
- D. Installer Qualifications: Company specializing in installing the products specified in this section with minimum three years documented experience, and certified by the State as fire alarm installer.
- E. Products: Listed and classified by Underwriters Laboratories, Inc as suitable for the purpose specified and indicated.

#### 1.8 MAINTENANCE SERVICE

- A. Division 01: Maintenance service.
- B. Furnish service and maintenance of fire alarm equipment for one year from Date of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from all possible damage. Sequence deliveries to avoid delays, but minimize on-site storage.

#### 1.10 COORDINATION

- A. Division 01: Pre-Installation conferencing.
- B. Coordinate the installation of cable and equipment with other construction activities and the work of other sections.

#### 1.11 WARRANTY

- A. Contractor's Warranty: Warranty the installation to be free of defect for a period of two (2) years.

- B. Equipment Warranty: Each piece of equipment shall carry a two(2) year manufacturer's warranty.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

- A. Notifier (Basis of Design)
- B. Edwards
- C. Siemens
- D. Tyco SimplexGrinnell
- E. Substitutions: See Division 01 – Product Requirements

### 2.2 CONTROL PANEL

- A. Basis of design:
  - 1. Notifier NFS-640 addressable control panel
- B. Product Description: Modular fire alarm control panel (FACP) with surface wall-mounted enclosure and shall contain a microprocessor-based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, annunciators, and other system controlled devices.
- C. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:
  - 1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
  - 2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
  - 3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
- D. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, relays, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes.
- E. Batteries
  - 1. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
  - 2. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

3. If necessary to meet standby requirements, external battery cabinet and charger systems may be used.
- F. Remote Transmissions:
1. Provide local energy or polarity reversal or trip circuits as required.
  2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
  3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
  4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.
- G. Field Programming
1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
  2. All field defined programs shall be stored in non-volatile memory.
- H. Digital Alarm Communicator Transmitter (DACT, or UDACT). The DACT is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station.
1. The DACT shall be an integral component of the fire alarm control panel requiring no interconnecting wiring or supervisory circuitry.
  2. The DACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to two different telephone numbers.
  3. The DACT shall be completely field programmable locally from the control panel keypad or remotely over a phone line using upload/download PC software.
  4. The DACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
  5. Communication shall include vital system status such as:
    - a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
    - b. Independent Addressable Device Status
    - c. AC (Mains) Power Loss
    - d. Low Battery and Earth Fault
    - e. System Off Normal
    - f. 12 and 24-Hour Test Signal
    - g. Abnormal Test Signal (per UL requirements)
    - h. EIA-485 Communications Failure
    - i. Phone Line Failure
  6. The DACT shall support independent zone/point reporting when used in the Contact ID format. In this format, the DACT shall support the transmission of up to 50 addressable points with the system. This enables the central station to have exact details concerning the location of the fire for emergency response.
  7. Provide connections to the building LAN and hardwired POTS dial-out lines as indicated in drawings.
  8. Provide two(2) hardwired POTS dial-out lines to the DACT, and program two(2) phone numbers for the system.

## 2.3 INITIATING DEVICES

- A. Addressable Manual Pull Station

1. Product Description: Manual addressable double-action station with break-glass rod.
  2. Mounting: Semi-Flush in finished spaces and Surface in unfinished spaces.
  3. Type: Non-coded.
  4. Backbox: Manufacturer's standard.
  5. Provide manual station guards on EACH manual station within the building. Station guards equal to "Stopper II" with audible horn.
- B. Addressable Heat Detector
1. Product Description: Addressable combination rate-of-rise and fixed temperature, spot heat detector.
  2. Temperature Rating: 135 degrees F (57 degrees C).
  3. Rate-of-Rise: 15 degrees F (8.3 degrees C).
  4. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
  5. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet.
- C. Addressable Photoelectric Ceiling Smoke Detector
1. Product Description: NFPA 72, addressable photoelectric type ceiling smoke detector with the following features:
    - a. Adjustable sensitivity.
    - b. Plug-in base
    - c. Visual indication of detector actuation.
  2. Mounting: 4 inch (102 mm) outlet box.
  3. Furnish two-wire detector with common power supply and signal circuits.
  4. The smoke detector shall be capable of providing three distinct outputs from the control panel. The outputs shall be from an input of smoke obscuration, a thermal condition or a combination of obscuration and thermal conditions.
  5. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
- D. Addressable Carbon Monoxide Detector
1. Detectors shall meet UL2034 and UL2075.
  2. Detectors shall be ceiling mounted.
  3. Detectors shall be connected to the fire alarm system and shall have supervised circuits.
  4. Detectors shall be addressable and may be in combination with a smoke detector.
  5. Detectors shall be connected as a separate zone or programmed as a separate zone and shall only activate a supervisory signal at the main fire alarm control panel and at the remote annunciator panel.
  6. Detectors shall not activate the building evacuation system.
- E. Addressable Duct Smoke Detector
1. Product Description: NFPA 72, addressable photoelectric type with the following features:
    - a. Auxiliary SPDT relay contact.
    - b. Duct sampling tubes extending width of duct.
    - c. Visual indication of detector actuation.
    - d. Duct-mounted housing.
  2. Furnish two-wire detector with common power supply and signal circuits.
  3. Furnish and install a remote test switch for each duct smoke detector, flushed into nearest accessible ceiling.

- F. 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 SLCs.
  2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
  3. The IDC zone shall be suitable for Style D/Class A or Style B/Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
  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 (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.
- G. Addressable Control Module
1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances.
  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 a current rating of 2 Amps for Style Z and 3 Amps for Style Y;
  4. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.

## 2.4 SIGNALING APPLIANCES

- A. Horns
1. The horn shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer horn capable of operation at 25.0 or 70.7 nominal Vrms. The horn shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
  2. A universal mounting plate shall be used for mounting ceiling and wall horn products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
  3. Horns shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Horn design shall isolate horn components to reduce ground fault incidents.
  4. The horn shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
  5. All notification appliances shall be backward compatible.
  6. Horns shall be connected to the local notification loop.
  7. **Combination horn/strobe devices shall meet the requirements specified under “Strobes” in addition to these specifications.**
- B. Strobes
1. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.

2. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and be fully synchronized.

## 2.5 CONDUIT AND WIRE

- A. Fire alarm cabling shall be wire in conduit, unless metal clad (MC) cable is specifically permitted to be installed by the Authority Having Jurisdiction, and is specified as an acceptable means of installation on the drawings.
- B. Metal Clad (MC) Cable:
  1. Type FPLP cable with galvanized interlocking steel with continuous red stripe.
  2. NEC Article 760 rating for fire alarm control cables.
  3. Install multiconductor cabling in accordance with NEC article 730.
  4. Use permitted above accessible ceilings and concealed within walls to devices. Provide conduit and wire for final homeruns to control panels, transponders and power supplies.
  5. Conductors shall comply with "Wire" paragraph below.
- C. Conduit:
  1. Conduit shall be in accordance with the National Electrical Code (NEC), local and state requirements.
  2. Where possible, 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.
  3. 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.
  4. Wiring for 24 volt DC 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.
  5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
  6. Conduit shall be 3/4 inch (19.1 mm) minimum.
  7. All fire alarm junction boxes and raceways shall be identified and labeled in accordance with Section 26 05 33, "Identification for Electrical Systems".
- D. Wire:
  1. All fire alarm system wiring shall be new.
  2. 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 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.
  3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
  4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
  5. Wiring used for the SLC multiplex communication loop shall be twisted and shielded and support a minimum wiring distance of 10,000 feet. The system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication loop.
  6. All field wiring shall be completely supervised.

7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs).
- E. Terminal Boxes, Junction Boxes and Cabinets: All boxes and cabinets shall be UL listed for their use and purpose.
- F. Initiating circuits shall be arranged to serve like categories (manual, smoke). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
- G. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Division 01: Coordination and project conditions.
- B. Verify products and systems receiving devices are ready for installation.

#### 3.2 INSTALLATION

- A. Division 1 - Quality Control: Manufacturer's instructions.
- B. Install manual station with operating handle 4 feet above finished floor.
- C. Install audible and visual signal devices 6 feet 8 inches above finished floor.
- D. Install 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors, or as indicated on drawings.
- E. Automatic Detector Installation: Conform to NFPA 72E and NFPA 720 (remotely located from heating appliances as possible).
- F. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- G. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- H. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas, or on existing block constructed walls with no means to fish wiring.

- I. Locate intelligent CO detectors as far away from CO source (fossil fuel burning appliance) as practical to minimize false alarms while maintaining manufacturer spacing criteria and NFPA required coverage.
- J. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Field technicians shall be NICET Level 1 (minimum) certified.
- K. The factory trained technician shall install initial data and artwork at each interactive firefighter's display.
- L. The factory trained technician shall design the graphic layout based on area diagrams and floor plans.

### 3.3 MANUFACTURER'S FIELD SERVICES

- A. Division 01: Manufacturer's field services.
- B. Include services of factory certified technician to supervise installation, adjustments, final connections, and system testing.

### 3.4 TEST

- A. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72 and the following:
  - 1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
  - 2. Open initiating device circuits and verify that the trouble signal actuates.
  - 3. Open and short signaling line circuits and verify that the trouble signal actuates.
  - 4. Open and short notification appliance circuits and verify that trouble signal actuates.
  - 5. Ground all circuits and verify response of trouble signals.
  - 6. Check presence and audibility of tone at all alarm notification devices.
  - 7. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
  - 8. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
  - 9. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
- B. Test carbon monoxide detectors and any associated alarms in accordance with NFPA 72H, NFPA 720, manufacturer's instructions and local fire department requirements.

### 3.5 FINAL INSPECTION/ ACCEPTANCE TESTING

- A. Division 01 – Quality Control.
- B. At the final inspection, a factory trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

- C. Fire Alarm/Acceptance Testing Procedures:
  - 1. The fire alarm testing shall be as the authority having jurisdiction shall dictate. This will be as determined by the AHJ and shall include, but not be limited to, the requirements as set below:
    - a. Protective Signaling Systems: All protective signaling systems shall meet with acceptance testing requirements of the applicable standards listed in NFPA 101 and NFPA 13.
    - b. Prior Test Notification: At least five (5) working days prior to testing, the Electrical Contractor shall notify (in writing) the following people of the proposed date the acceptance tests are to be performed:
      - 1) Authority Having Jurisdiction
      - 2) General Contractor or Construction Manager
      - 3) Engineer of Record
      - 4) Equipment Supplier Representative
      - 5) HVAC Contractor (if applicable)
- D. Certificates of Compliance:
  - 1. A Fire Alarm System Inspection and Testing Certification and Description form shall be prepared for each system per the requirements listed in NFPA 72, Chapter 7.
  - 2. After the completion of the operational acceptance tests and sign-off of test witness (with stipulations noted), final copies of the Certificates shall be forwarded to the AHJ.
- E. Tests:
  - 1. All tests shall be conducted in accordance with the Manufacturer's Testing Recommendations.
  - 2. All testing equipment, apparatus (i.e. sound level decibel meter, 2-way radio communication, test devices, ladders, tools, lighting, etc.) and personnel shall be supplied by the Electrical Contractor.

### 3.6 INSTRUCTION

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation" to the Owner.
- C. Manufacturers representative shall provide Owner with a minimum of four (4) hours of onsite training on system. This training shall be followed up with an additional four (4) hours of onsite instruction at the discretion of the Owner, at any time during the warranty period.