PROJECT MANUAL

FOR

21st CENTURY LEARNING CENTER RENOVATIONS AT THE BARNSTABLE HIGH SCHOOL LIBRARY

BARNSTABLE, MASSACHUSETTS

TOWN OF BARNSTABLE

Technical Specifications

March 8, 2018

Prepared by:

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21st CENTURY LEARNING CENTER RENOVATIONS

BARNSTABLE HIGH SCHOOL LIBRARY **# OF PAGES**

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Barnstable High School Library
21st Century Learning Center
Barnstable, Massachusetts
CBI JOB NO.: 16165-D

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TECHNICAL SPECIFICATIONS

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 10 00 SUMMARY OF WORK

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 PROJECT

A. Project Name: 21st Century Learning Center Renovations at the Barnstable High School Library.

B. Project Location

1. 744 West Main Street
   Hyannis, MA 02601

C. Owner's Name: Town of Barnstable.

D. Architect's Name: CBI Consulting LLC.

1.03 WORK UNDER THIS CONTRACT

A. The work to be done under this contract consists of executing and completing all work required for the 21st Century Learning Center Renovations at the Barnstable High School Library in Hyannis, MA.

B. In general, the Contractor shall supply all material, labor, equipment, insurance, temporary protection, tools and appliances necessary for the proper completion of the Work as described in the Plans and Specifications, in accordance with good construction practice, and as required by the materials manufacturers.

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C. Supply all shoring and protection necessary to protect the occupants, building site, building systems, and landscape areas. All means and methods are the responsibility of the Contractor. The Contractor is solely responsible for safety on the job site.

D. All materials shall be new and of the best quality.

E. General Information

1. If there is a conflict between or within any part of the plans and the specifications, the more stringent requirement shall apply at the sole discretion of the Architect.

2. This document describes (but is not exclusive of) the replacement of rooftop units including all associated appurtenances, ductwork, and controls, as indicated in the Drawings and Specifications. The work shall be constructed so as to meet all requirements of the Massachusetts State Building Code, current edition, in addition to all other applicable codes and regulations.

3. The work shall be performed while the rest of the School is occupied by students and staff, for the duration of the project. The rooms within the Limit of Work will not be occupied during construction

F. The work will include all operations necessary to deliver the building(s) and ancillary on and off-site amenities in a fully installed and operable condition including all utility andsite work and obtaining all necessary licenses, permits, and certificates.

G. The following is the scope of work. All work required without limiting the generality thereof includes all labor, materials, equipment, and services required to perform thework fully in the drawings and specifications and includes, but is not limited to, thefollowing:

1. General:

a. Repair and/or replace all landscape areas, turf areas, walkways and pavements that have been disturbed by the work or Contractor activities to their originalcondition and to the complete satisfaction of the Owner and Architect.

b. All Contractor lay-down, storage, dumpsters, etc. shall be limited to the area indicated on the Site Plan. Provide a Site Utilization Plan for approval.

c. There will be other work (by Owner) occurring at the school, including curtainwall replacements and interior glazed partitions. The Contractor shall cooperate with and schedule all work to accommodate the Town of Barnstable and the Barnstable Public Schools.

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2. Work by HVAC Filed Sub-Bidder:

   a. Remove and dispose of Rooftop Units #7 – 9 on the Library Roof. Coordinate extent of demolition of associated hot water piping, ductwork, controls, wiring, etc. with the Mechanical Drawings and Specifications. Install Rooftop Units #7 - 9 as scheduled, with adapter cubs to fit onto existing curbs. Install all appurtenances for a complete working system, including all controls, dampers, and wiring. After installation, provide epoxy painting to all exposed surfaces of rooftop units.

   b. Provide phase protection at all rooftop units.

   c. Remove and dispose of existing fin tube radiators at the base of all curtainwall assemblies inside the Library. Install new radiators in same locations, as indicated on the Mechanical Drawings and Specifications.

   d. Install return air ductwork to extend down brick wall from the 2-story high ceiling above. Exposed ductwork shall be galvanized spiral, with flat seam flanges, and secured to brick wall.

   e. Modify and extend supply and return air to and from Room H119-b and connect to existing.

   f. Disconnect and remove all existing-to-remain ceiling supply air diffusers and return air grilles in ceilings scheduled to be removed, and reinstall existing diffusers and grilles after ceilings are re-installed.

   g. Remove and dispose of all diffusers and grilles in the 2-story high plaster ceiling scheduled to be demolished. Provide and install supply air diffusers in suspended acoustic tile ceiling in the 2-story high space where the plaster ceiling was demolished.

   h. Insulate all exiting-to-remain exposed ductwork above the 2-story high plaster ceiling.

   i. Provide all vibration control and seismic restraint for all work of the Contract including, but not exclusive of, work by Electrical Filed Sub-Bidder and Fire Protection Contractor.

3. Work by ELECTRICAL Filed Sub-Bidder:

   a. Remove and dispose of existing recessed lighting and paddle fans in the plaster ceiling of the two-story Library in their entirety.

   b. Install lighting and controls (with daylight harvesting) in suspended acoustic tile ceiling and grid in the 2-story high space

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where the plaster ceiling was demolished.

c. Provide and install motorized projector screen in front of the large curtainwall in suspended acoustic tile ceiling and grid in the 2-story high space where the plaster ceiling was demolished. Secure to structure above.

d. Remove and dispose of existing lighting in Room H119-b. Install lighting and controls in Room H119-b as indicated on the Drawings.

e. Remove and dispose of existing soffit light above the circulation desk.

f. Make safe (including securing to structure above) all existing light fixtures in ceilings scheduled for removal. Refer to Reflected Ceiling Plans.

g. Provide temporary lighting for all trades, for the completion of the work.

h. Modify, extend and re-route existing power and data locations. Refer to Electrical Drawings for extent.

i. Remove and dispose of existing feeders, and provide new feeders and conduits to rooftop units.

j. Provide lightning protection at all rooftop units.

4. Work by RESILIENT FLOORING Filed Sub-Bidder:

a. Prepare existing concrete slab floor to receive new flooring as specified.

b. Install 3mm adhered Luxury Vinyl Tile (LVT), where scheduled on the Drawings, with 4 inch rubber base at full perimeter.

c. Install Vinyl Composite Tile floor, adhered, where scheduled on the Drawings, with 4 inch rubber base at full perimeter.

d. **Add Alternate #1**: In lieu of 3 mm adhered LVT, install 5mm floating LVT.

5. Work by ACOUSTICAL TILE Filed Sub-Bidder:

a. Carefully remove, store, and protect existing tectum and acoustical ceiling tiles and grid, to accommodate work above. Refer to Reflected Ceiling Plan for extent, and coordinate with HVAC Contractor. At completion of work above, reinstall ceilings in their original location. Replace 10% of all ceiling tiles and grid removed with new to match existing.

b. At the demolished plaster ceiling in the 2-story high space, install

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acoustical ceiling tile and grid. At Room H119-b, install acoustical ceiling tile and grid.

c. At the recessed soffit above the circulation desk, install acoustical ceiling tile and grid.

d. **Add Alternate #1**: In lieu of the specified base bid acoustic ceiling tiles, install acoustic ceiling tiles with a NRC of 0.85 or better.

e. **Add Alternate #2**: Install sound-absorbing glass fiber acoustic panels, total of 1,000 SF at small individual locations throughout the full-height of the existing interior brick and gypsum wallboard walls. Refer to Interior Elevations for general size and arrangement of panels.

6. Work by GENERAL Bidder:

a. Cut back PVC membrane roof at rooftop units to expose curb. Raise curb heights and install PVC flashing hot air welded to existing roofing and fully wrapped over top of raised curbs.

b. Remove and dispose of low wood railing at the Stair and Mezzanine guardrail, including metal brackets. Grind metal post smooth at bracket locations, prime and paint.

c. At low guardrail locations, provide and install guardrail extension to match existing.

d. At stair to Mezzanine, provide and install code-compliant metal handrail including extensions.

e. Remove and dispose of all existing carpet flooring down to existing concrete slab floor, and remove and dispose of all rubber base at perimeter of carpet floors where scheduled on the Drawings.

f. Remove and dispose of built-in wood circulation desk in its entirety.

g. Remove and dispose of VCT floor and rubber base in Room H210.

h. Remove and dispose of plastic grate soffit above circulation desk in its entirety.

i. Remove and dispose of existing plaster ceiling in the 2-story high space in its entirety.

j. Saw cut existing concrete floor slab for under-slab power and data extensions, fill, and install new slab pinned to, and flush with, existing adjacent slab. Refer to Detail #4/A6-01.

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Coordinate final locations and extent with Electrical Contractor.

k. Modify and extend existing fire protection to provide coverage to both sides of the glass partition (glass partition and stud wall above ceiling by separate Contractor) in Room H119-b.

l. Remove existing paintings on 2-story high brick wall, and relocate to new locations on brick wall.

m. Remove gypsum wallboard under curtainwall on East wall of 2-story high space, and install 5/8 inch gypsum wallboard, taped and painted.

1.04 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in the contract documents portion of the project manual.

1.05 OWNER OCCUPANCY

A. Owner intends to occupy the Project during construction.

B. The School Department will not allow access to other portions of the building at any time unless accompanied by authorized Barnstable Public School staff. The majority of the work shall take place over the summer while classes are not in session, but portions of the work are expected to take place at the end of the 2017-2018 academic calendar year, and at the beginning of the 2018-2019 academic calendar year.

C. Cooperate with Owner and Owner's Project Manager to minimize conflict and disturbance, and to facilitate Owner's operations and the School Department's Schedule. Cooperate with any changes in the School Schedule or changes to other Contractor's scheduled work in the Library.

D. Schedule the Work to accommodate Owner occupancy and school schedule.

1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas of the Building specifically indicated to receive work. Contractors shall not roam halls or be allowed into areas of the building that are not scheduled for work. Contractors shall not use the roof hatches for access to the roof.

B. Arrange use of site and premises to allow:

1. Owner occupancy.

2. Work by Others.

3. Work by Owner.

a. Repair work will be ongoing in the building throughout the duration of the project.

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b. Cooperate with Owner's staff and separate contractors in all work that is to be performed.

4. Use of site and premises by the public.

C. Provide access to and from site as required by law and by Owner:

1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered. Provide protected cover over all exterior doors.

2. Do not obstruct roadways, sidewalks, or other public ways without permit.

D. Existing building spaces may not be used for storage.

E. Time Restrictions: Limit conduct of work to the hours of 7 AM – 4 PM.

F. Utility Outages and Shutdown:

1. Limit disruption of utility services to hours the building is unoccupied.

2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days' notice to Owner and authorities having jurisdiction.

3. Prevent accidental disruption of utility services to other facilities.

1.07 EXAMINATION OF SITE AND DOCUMENTS

A. A pre-bid conference will be held at the location, date and at the time indicated in the Invitation to Bid.

B. The bidders are expected to examine and to be thoroughly familiar with all contractdocuments and with the conditions under which the work is to be carried out. The Owner will not be responsible for errors, omissions, and/or charges for extra work arising fromthe General Contractors or Subcontractors failure to familiarize themselves with thecontract documents, that they are familiar with the conditions and requirements of bothwhere they require, in any part of the work a given result to be produced, that the contract documents are adequate and they will produce the required results.

C. All bidders must inspect the existing site and make their own assessment of the work required to achieve the complete, finished conditions specified in the Contract Documents.

D. Failure to adequately inspect the site and/or correctly assess existing conditions shall not be cause for additional payment.

E. Every contractor will be bound by the scope of work of the Contract Documents and shall make the inspections necessary to assure that the bid price includes the complete scope.

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1.08 SUPERVISION OF WORK

A. The Contractor shall be held directly responsible for the correct installation of all workperformed under this Contract. The Contractor must make good repair, without expense to the Owner, of any part of the new work, or existing work to remain, which may become inoperative on account of leaving the work unprotected or unsupervised during construction of the system or which may break or give out in any manner by reason of poor workmanship, defective materials or any lack of space to allow for expansion and contraction of the work during the Contractor's warranty period, from the date of finalacceptance of the work by the Owner.

B. The Contractor shall furnish a competent Massachusetts licensed superintendent approved by the Owner and Architect. The licensed superintendent shall supervise allwork under this contract and who shall remain on duty at the site throughout the Contract period while work is in progress.

1.09 FIELD MEASUREMENTS

A. Although care has been taken to ensure their accuracy, the dimensions shown for existing items and structures are not guaranteed. It is the responsibility of the Contractor to verify these dimensions in the field before fabricating any construction component.

No claims for extra payment due to incorrect dimensions will be considered by the Owner.

1.10 DAMAGE RESPONSIBILITY

A. The Contractor shall repair, at no cost to the Owner, any damage to building elements, site appurtenances, landscaping, utilities, etc. caused during demolition operation andwork of this Contract.

B. The Contractor shall secure the work area and equipment at the end of each workday.

1.11 OWNER FURNISHED PRODUCTS

A. Products indicated “N.I.C.” (Not in Contract), or “E. O.” (Equipment by Owner), or“O.F.O.I.” (Owner Furnished Owner Installed), or other similar acronyms as defined in the contract documents will be furnished and installed by the Owner. Coordination andprovision of service lines for such products shall be included under these ConstructionContract Documents.

1.12 INTENT OF THE PROJECT MANUAL

A. Words in the singular shall also mean and include the plural, wherever the context so indicates, and words in the plural shall mean the singular, wherever the context soindicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall

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mean "noted", "indicated", "scheduled", "detailed", or shall refer to any other diagrammatic or written reference made on the drawings.

C. Wherever the terms "furnish", "install" or "provide" are used in the contract documents, it shall mean to "connect", "apply", "erect", "construct", or similar terms in order tomake operative, and to supply all labor and materials, including miscellaneous fittings, hardware, and accessories necessary to complete the installation of the specified item.

D. All the work of the project is "related" in some fashion either by direct contract, sequencing, or coordination. It is the Contractor's responsibility to perform all the work and coordinate all the various trades and types of "related" work in order to meet theschedule and quality standards of the Project.

E. Means and methods of construction as well as compliance with OSHA and all othersafety laws and regulations is the exclusive responsibility of the Contractor, his Subcontractors, suppliers, consultants, and servants. The Architect does not have control of the job site.

F. Wherever the term "material" is used in the specifications it will mean any "product","equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specifications reference or to other description.

G. The terms "approved" or "approval" shall mean the written approval of the Owner or Architect.

H. The term "specifications" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined herein, except for the drawings

I. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed", and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Owner or Architect; the terms "approved", "acceptable","satisfactory", and similar words shall mean approved by, acceptable or satisfactory tothe Owner or Architect; and the terms "necessary", "responsible", "proper", "correct",and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Owner or Architect.

J. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

K. "Exposed" means not installed underground or "concealed" as defined above.

L. “Removed” means complete removal of item, and complete disposal in an approved manner.

1.13 ERRORS, OMISSIONS, AND CONFLICTS IN THE PROJECT MANUAL

A. In the case of conflicts in the Drawings and the Specifications noticed by the Contractor, the Architect shall be notified immediately in writing of such errors

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and/or omissions. In no case shall the Contractor proceed without written authorization from the Architect.

B. If there is a conflict between or within any part of the plans and the specifications, the more stringent requirement shall apply at the sole discretion of the Architect.

1.14 UNFORESEEN FIELD CONDITIONS

A. In the case of unforeseen field conditions, the Contractor shall notify the Owner and Architect immediately in writing of such conditions. In no case shall the Contractor proceed without written authorization from the Architect. If such unforeseen conditions result in additional expense, the Contractor shall not proceed without the written approval of the Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 20 00 PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.03 SCHEDULE OF VALUES

A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

B. Forms filled out by hand will not be accepted.

C. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization.

E. Include in each line item, the amount of Allowances specified in this section. For

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unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement Submit Pencil Requisition for Owner, OPM and Architect's approval prior to submitting Application for Payment.

B. Forms filled out by hand will not be accepted.

C. For each item, provide a column for listing each of the following:

1. Item Number.
2. Description of work.
3. Scheduled Values.
4. Previous Applications.
5. Work in Place and Stored Materials under this Application.
6. Total Completed and Stored to Date of Application.
7. Percentage of Completion.
8. Balance to Finish.
9. Retainage.

D. Execute certification by signature of authorized officer.

E. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

F. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.

G. Submit six (6) copies of each Application for Payment.

H. Include the following with the application:

1. Transmittal letter as specified for Submittals in Section 01 30 00.
2. Construction progress schedule, revised and current as specified in Section 01 30 00.
3. Certified Payrolls.
4. Partial release of liens from major Subcontractors and vendors.
5. Project record documents as specified in Section 01 78 00, for review by Owner which will be returned to the Contractor.

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6. Affidavits attesting to off-site stored products.

I. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.

B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

C. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.

1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.

2. Promptly execute the change.

D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 5 days.

E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 60 00.

F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.

2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.

3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.

4. For change ordered by Architect without a quotation from Contractor, the

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amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.

G. Substantiation of Costs: Provide full information required for evaluation.

1. On request, provide the following data:

a. Quantities of products, labor, and equipment.

b. Taxes, insurance, and bonds.

c. Overhead and profit.

d. Justification for any change in Contract Time.

e. Credit for deletions from Contract, similarly documented.

2. Support each claim for additional costs with additional information:

a. Origin and date of claim.

b. Dates and times work was performed, and by whom.

c. Time records and wage rates paid.

d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

K. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:

1. All closeout procedures specified in Section 01 70 00.

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PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 23 00 ALTERNATES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 ALTERNATE SCOPE

A. This Section lists the Alternates which appear in the Contract Documents. Consult the individual sections of the detailed requirements of each Alternate.

B. Bid prices for each Alternate shall include overhead, profit, and all other expenses incidental to the Work under each Alternate.

C. The Contractor and Subcontractors shall be responsible for examining the scope of each Alternate generally defined herein and for recognizing modifications to the Work caused by the Alternates and including the cost thereof in the bid price.

1. **ADD ALTERNATE #1**: In lieu of installing 3mm adhered Luxury Vinyl Tile, install 5mm floating Luxury Vinyl Tile. Also, in lieu of installing specified base bid Acoustic Ceiling Tiles, install Acoustic Ceiling Tiles with a Noise Reduction Coefficient (NRC) of 0.85 or better.

2. **ADD ALTERNATE #2**: Install sound-absorbing glass fiber acoustic panels, total of 1,000 SF at small individual locations throughout the full-height of the existing interior brick and gypsum wallboard walls. Refer to Interior Elevations for general size and arrangement.

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 30 00 ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. Preconstruction meeting.

B. Project Coordination

C. Site mobilization meeting.

D. Progress meetings.

E. Construction progress schedule.

F. Daily Reports

G. Progress photographs.

H. Submittals for review, information, and project closeout.

I. Number of copies of submittals.

J. General Notes

K. Insurance

L. Submittal procedures.

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1.03 RELATED REQUIREMENTS

A. Section 01 32 16 - Construction Progress Schedule: Form, content, and administration of schedules.

B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 01 78 00 - Closeout Submittals: Project record documents.

1.04 PROJECT COORDINATION

A. Owner's Project Manager (OPM): Mark Marinaccio.

B. Cooperate with the OPM and the School Department's authorized representative in allocation of mobilization areas of site; for field offices and sheds, for site access, traffic, and parking facilities and enclosures and protection of building and site areas.

C. During construction, coordinate use of site and facilities through the OPM.

D. Comply with OPM's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

E. Comply with instructions of the OPM for use of temporary utilities and construction facilities.

F. Coordinate field engineering and layout work under instructions of the Project Coordinator.

G. Coordination with Building Procedures

1. The safety and welfare of the students, staff, and guests of the Barnstable High School are the utmost concern of the project. All work by the Contractor, his Sub-Contractors, suppliers, and employees shall be performed in a way that will safeguard this concern. Safety is the sole responsibility of the Contractor on the jobsite. Extraordinary care must be taken throughout the project to coordinate work activities with the School schedules, procedures, and activities.

2. All construction activities and deliveries to the site are to be coordinated with the OPM and the School Department's authorized representative.

3. Pre-construction meeting shall be held with the Owner’s Project Manager, the Contractors, and Architect, to coordinate locations for dumpsters and chutes, deliveries, worker parking, material storage, as well as to discuss safety, scheduling, and procedures.

4. Contractor shall restrict hazardous items and activities to locations that will have the least impact on the daily operations. All material storage,

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locations of cranes, dumpsters, workers access, etc. will be only in areas approved by the OPM and the School Department's authorized representative.

5. Install, at a minimum, when work is performed overhead, covered walkway protection at all entrance and exit doors, at areas of construction, to the facility during construction activities, 10'-0" minimum length, of pipe scaffolding, plywood, planking, orange plastic fencing, and yellow safety tape. Safety is the soleresponsibility of the contractor, regardless of the information in this specification.

6. Contractor shall provide signage and other safety barriers at the site and within the building adequate to support their safety program.

7. The Contractor shall provide, erect and maintain barricades with any required egress, access doors, lighting, ventilation, guard rails and all other appurtenances required to protect the general public, visitors, staff, and workers while construction is in progress. Safety is the sole responsibility of the Contractor on the job site.

8. Contractor shall provide all protections necessary for the safety of the building and its occupants. All protections shall be removed immediately upon completion of the work. Dust and debris shall be immediately cleaned and vacuumed to the satisfaction of the OPM and School Department's authorized representative. Damage as a result of the work will be repaired to the satisfaction of, and at no additional cost to, the Owner.

1.05 CORI REQUEST FORM

A. All personnel working at the sites will be required to fill out a Barnstable Public Schools CORI request form.

1. All forms shall be submitted to Barnstable Public Schools one week prior to the applicant being on site.

2. The General Contractor will update the list as required to reflect current workers on site.

3. All workers must pass the CORI background check in order to work on this site.

B. The General Bidder, all of the Filed Sub-Bidders, and all of the sub-contractors are hereby notified that CORI checks are required for all personnel that will be working on site at any of the Town of Barnstable School properties. It is each individual contractor's responsibility to submit the required paperwork to the State, in advance of the work, so as not to delay the schedule for any possible employee that will access the site. Approval by the state for must be delivered to the Owner in advance of the work. Payments will be withheld to the contractor if he/she fails to

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submit the proper CORI certifications in advance of the work.

1.06 SCHEDULING

A. Time is of the essence in this project.

1. Temperature is a critical factor in the construction work. Adhere to manufacturer's specifications and installation instructions.

2. The anticipated Start Date of the Work is June 1, 2018. All work shall be substantially complete by September 21, 2018

3. The School Department will not allow access to other portions of the building at any given time during the school year. The Contractor shall work with the School Department to establish a schedule of operations to accommodate the School Department. The Contractor shall not work inside any rooms that are occupied by teachers and students.

4. The work must be completed in a continuous uninterrupted operation. The Contractor must use sufficient personnel and adequate equipment to complete all the necessary work requirements within a minimum period of time.

5. Unless specifically authorized by the Owner, in writing, the work must be conducted between the hours of 7:00 a.m. and 4:00 p.m. on Monday through Friday. No work is to be done on holidays or Weekends unless approved by the Owner in advance.

6. The Contractor is responsible for the security and stability of partially completed work until the project is accepted by the Owner.

B. The Contractor shall schedule the work of this Contract so as to perform and complete the Work of the Contract according to the following schedule. The Contractor shall within seven (7) days of the Notice of Contract Award, submit a schedule to the Owner and Architect for review.

C. Between the time period of the general bid due date and Construction Commencement, the Contractor shall take all necessary measures to complete the Work of this Contract. It is expected that the Contractor utilize the time period between the bid date and construction start date to schedule and coordinate the work and work sequence, prepare shop drawings and submittals for approval and order materials. The Owner shall issue a Notice to Proceed. If the work is not complete by the completion date, the Contractor will be subject to liquidated damages.

D. The Contractor shall be responsible for providing any and all measures and/or temporary construction required to control the transmission of dust, particles, and fumes from construction activities.

E. The Contractor shall be responsible on a daily basis for informing the designated Owner’s representative of all persons on-site that day associated with the Work. The Contractor shall establish a daily reporting system of all activities which is

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acceptable to the Owner.

F. The Construction schedule shall indicate the dates for start and completion of each work item or task required with all milestones using a Bar Chart subject to approval by the Architect.

G. Contractor shall update the Construction schedule weekly. Requisitions for payment must be accompanied by an updated schedule. The on-site superintendent shall meet with the Owner's Authorized Representative daily to inform them of the daily progress and review the schedule for the next three (3) days.

H. The Awarding Authority's review of the project construction schedule shall not extend to the accuracy or other matters dealt with in the schedule, including but not limited to whether work is omitted, whether duration of activity is reasonable, the level of labor, materials or equipment, the Contractor's means, methods, techniques, procedures or sequence of construction, or whether the sequence and timing for work remaining are practical. The accuracy, correctness of all work, sequencing, and schedules shall remain the sole responsibility of the Contractor. Neither the Awarding Authority's review of a schedule nor a statement of resubmittal not required shall relieve the Contractor for the responsibility for complying with the contract schedule, adhering to sequences of work, or from completing any omitted work with the Contract Time.

1.06 COORDINATION

A. The Contractor shall submit for approval to the Owner and OPM a detailed operational plan showing the sequence of operations prior to commencement of any work at the site. Any changes to this operational plan must be approved by the Owner and OPM.

B. The Contractor must retain on the Work during its progress a competent full-time non-working licensed construction superintendent, satisfactory to the Owner. This representative shall not be changed, except with the consent of the Owner. The representative shall be in full charge of the work and all instructions given to this person by the Architect shall be binding.

C. The Owner shall assist the Contractor to perform the Work in accordance with the approved operational plan.

D. The Contractor shall provide:

1. Notification to the Owner two (2) weeks before any work is scheduled at the site/building.

2. Notification to the Owner in writing forty-eight (48) hours before work is scheduled in any particular area.

3. An updated schedule monthly with the application for payment. Payments will not be authorized until the updated schedule is received and approved.

4. The Contractor must supply to the Owner the cell phone number of a

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responsible person who may be contacted during non-work-hours for emergencies on the Project.

1.07 SUBCONTRACTORS

A. Subcontractors are subject to approval by the Owner.

1.08 CONSTRUCTION REVIEW

A. All materials and workmanship shall be subject to review by the Architect and all designated representatives of the Owner. Such review may take place at any time during the construction, and wherever work relating to this project is underway. The Contractor shall notify the Architect of any approaching stage of the work likely torequire his/her attention, and the Architect shall have the right to reject all defectiveor non-conforming workmanship and material, and to require its replacement.

1. If any un-reviewed work is covered up without approval, the Contractor shall bear the costs of uncovering it upon request.

1.09 CODES

A. Codes, standards, and publications of private and public bodies mentioned in thesespecifications, and other such standards and specifications, refer to the latest edition thereof at the time of taking bids unless a specific edition is designated, and shall be considered and integral part of the Contract Documents.

1.10 COORDINATION OF WORK

A. Contractor shall coordinate all construction work with the Owner's Project Manager.

B. Contractor is responsible for all building and sidewalk permits, police details as required as well as any other requirements that may be imposed by the Town.

C. After the demolition and removal of the existing roofing, the Contractor shall be responsible for the protection and security of the roof decks and interior spaces below prior to the installation of the new roofing (same day).

1.11 FIELD MEASUREMENTS

A. Before ordering any materials or performing any work, the Contractor or his/her subcontractors shall inspect all existing conditions and perform all measurements atthe building. No extra charge or compensation will be allowed because of differences between the drawings and the actual dimensions. Any differences between the Project Manual and the actual conditions found shall be submitted to the Architect for direction before proceeding with the work.

1.12 CUTTING AND PATCHING

A. The work to be performed under this Contract shall include all cutting and patching necessary to accommodate new work.

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B. Each Filed Sub-Bidder shall be responsible for temporary removal, and removal and disposal of existing materials to accommodate their work, unless noted otherwise.

1.13 PERMITS

A. Procurement of building permits shall be the responsibility of the Contractor. Requests for inspections by the Building Inspector and the obtaining of required signatures by Inspection on permits is the responsibility of the Contractor. **Permit fees will NOT be waived**.

1.14 HOUSEKEEPING AND PROTECTION OF EXISTING CONDITIONS

A. Protections

1. Maintain the premises in a safe, orderly condition at all times. Protect construction, furnishings, equipment and other items.

2. Property Protection: The General Contractor shall take all measures necessary to protect the Owner's property.

3. Security: The General Contractor shall take every possible precaution to maintain the security of the buildings and site. The Contractor shall cooperate with the Owner fully and follow the Owner's directions as issued. The Contractor shall control and restrict access to areas of work to prevent injury to persons and property.

4. The Contractor shall properly cover, protect and maintain floor and finished surfaces to prevent damage. Replace protective coverings which become wet, torn or ineffective.

5. Roof and Finished Surfaces Protection:

a. The Contractor shall restrict traffic on roofs and finished surfaces to that required to perform the work of this Contract and permit traffic only required to properly complete the Work.

b. Effectively protect surfaces to prevent damages to existing substrates, new finishes, and to finished roofing work. Provide temporary walkways and work platforms as needed.

c. Load distribution: The Contractor and any Subcontractor shall not load or permit any part of the structure to be loaded in any manner that will damage the existing structure or endanger the safety of persons or property. Such loads shall include live and dead loads and all moving, vibratory, temporary and impact loads.

6. Correction by the Contractor

a. At no additional cost to the Owner, the General Contractor shall immediately correct all deficiencies, including damages to the building, site and site surfaces, damages to furnishings, damages to

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equipment or systems, damage to adjacent properties, and all other damage caused by the General Contractor or its Subcontractors during the execution of the Work of this Contract. Any and all damages resulting from inadequate, insufficient or defective temporary protections installed by the Contractor during the work of this Contract, shall be corrected by the General Contractor at no additional cost to the Owner

A. Requirements Related to Building Users' Furnishings, Equipment and Other Items

1. The General Contractor is responsible for protecting all furnishings, equipment and items from damage (including construction generated dust) during the entire construction period.

2. The General Contractor shall be responsible for moving and re-setting up all furniture, fixed and movable equipment, file and storage cabinets, recreation equipment, boxes, and all other items to accomplish the work of both the General Contractor and the Subcontractors in its entirety.

B. Dust, Dirt, and Fume Control

1. The Contractor shall take all necessary precautions and provide all necessary temporary construction to effectively contain dust, dirt and fumes within the areas of work and within the work limits. Temporary construction shall be provided to effectively prevent dust and dirt from entering areas of the buildings or adjacent buildings, satisfying all City, State and Federal laws, codes, and requirements.

C. Rubbish Removal

1. The Contractor shall remove all rubbish, waste, tools, equipment and appurtenances caused by and used in the execution of the Work; but this shall in no way be construed to relieve the Contractor of his primary responsibility for maintaining the building and Project site clean and free of debris, leaving all work in a clean condition and satisfactory to the Official.

2. Immediately after unpacking, the Contractor shall collect and remove from the building and Project site all packing materials, case lumber, excelsior, wrapping and other rubbish.

3. Rubbish removal shall occur so that trash and debris are contained in closed and secured waste containers.

D. Dumping

1. The contractor shall submit an affidavit certifying legal and proper dumping and disposal (including locations) of all materials from the project.

PART 2 PRODUCTS - NOT USED

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PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required:

1. Owner.
2. Owner's Project Manager.
3. Architect.
4. Contractor.

C. Agenda:

1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures
6. Designation of personnel representing the parties to Contract, Owner and Architect.
7. Review of Commissioning - related requirements, testing and procedures.
8. Distribution of Contact Information
9. Site Utilization Plan, for Owner approval, including review of all dumpster, lay-down/ storage areas, trailers and staging area locations.
10. Temporary Power and Water.
11. Inclement Weather.
12. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
13. Scheduling.

3.02 SITE MOBILIZATION MEETING

A. Owner will schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:

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1. Contractor.
2. Owner.
3. Architect.
4. Contractor's Superintendent.
5. Major Subcontractors.

C. Agenda:

1. Use of premises by Owner and Contractor.
2. Owner's requirements and occupancy prior to completion.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and building layout.
6. Security and housekeeping procedures.
7. Schedules.
8. Application for payment procedures.
9. Procedures for testing.
10. Procedures for maintaining record documents.
11. Requirements for start-up of equipment.
12. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Architect will make arrangements for regular job meetings, prepare agenda with copies for participants, preside at meetings.

B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Owner's Project Manager, Architect, as appropriate to agenda topics for each meeting.

C. Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.

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5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 5 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 5 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.05 PROGRESS PHOTOGRAPHS

A. Take photographs as evidence of existing project conditions.

3.06 DAILY PROGRESS REPORTS

A. Provide a copy of the daily superintendent report to the Owner's project manager's clerk daily.

3.07 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:

1. Product data.
2. Shop drawings.

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3. Samples for selection.

4. Samples for verification.

B. Provide submittals as indicated in Section 01 30 00; 3.10.

C. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

D. Samples will be reviewed only for aesthetic, color, or finish selection.

E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

F. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

3.08 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:

1. Design data.

2. Certificates.

3. Test reports.

4. Inspection reports.

5. Manufacturer's instructions.

6. Manufacturer's field reports.

7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.09 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout:

1. Project record documents.

2. Operation and maintenance data.

3. Warranties.

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4. Bonds.

5. Other types as indicated.

3.10 PRE-CONSTRUCTION PHOTOS

A. Contractor shall submit pre-construction photos on one CD that documents all pre-existing building and site conditions. All damages observed after construction shall be deemed the responsibility of the Contractor unless otherwise documented.

B. Submit for Owner's benefit during and after project completion.

3.11 NUMBER OF COPIES OF SUBMITTALS

A. Documents for Review. Provide electronically, digital copies of all submittals in addition to hard copies required:

1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, plus one copy to be retained at the project site, plus twocopies to be retained by the Owner, and two copies that will be retained by Architect.

2. Larger Sheets, Not Larger Than 36 x 48 inches: Submit the number of opaque reproductions that Contractor requires, plus one copy to be retained at the project site, plus two copies to be retained by the Owner, and two copies that will be retained by Architect.

B. Documents for Information: Submit two copies.

C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.

1. After review, produce duplicates.

2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

A. Transmit each submittal with a copy of approved submittal form.

B. Transmit each submittal with approved form.

C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

E. Schedule submittals to expedite the Project, and coordinate submission of related items.

F. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

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G. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

H. Provide space for Contractor and Architect review stamps.

I. When revised for resubmission, identify all changes made since previous submission.

J. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

3.13 GENERAL NOTES

A. CONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING AND COORDINATING ALL DIMENSIONS WITH ARCHITECTURAL DRAWINGS. IN CASE OF CONFLICT, THE ARCHITECT SHALL BE NOTIFIED AND SHALL RESOLVE THE CONFLICT.

B. IN ANY CASE OF CONFLICT BETWEEN THE DRAWINGS AND THE PROJECT SPECIFICATIONS, THE MORE STRINGENT REQUIREMENTS SHALL GOVERN.

C. THE CONTRACTOR SHALL MAKE NO DEVIATION FROM DESIGN DRAWINGS WITHOUT PRIOR REVIEW BY THE ARCHITECT.

D. WORK NOT INDICATED ON A PART OF THE DRAWINGS BUT REASONABLY IMPLIED TO BE SIMILAR TO THAT SHOWN AT CORRESPONDING PLACES SHALL BE REPEATED.

E. ALL WORK SHALL COMPLY WITH APPLICABLE CODES AND LOCAL LAWS AND REGULATIONS.

F. GENERAL CONTRACTOR SHALL COORDINATE LOCATIONS OF OPENINGS, PITS, BOXES, SUMPS, TRENCHES, SLEEVES, DEPRESSIONS, GROOVES, AND CHAMFERS, WITH MECHANICAL, ELECTRICAL AND PLUMBING TRADES.

G. THE STRUCTURAL DESIGN OF THE BUILDING IS BASED ON THE FULL INTERACTION OF ALL ITS COMPONENT PARTS. NO PROVISIONS HAVE BEEN MADE FOR CONDITIONS OCCURRING DURING CONSTRUCTION. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO MAKE PROPER AND ADEQUATE PROVISIONS FOR STABILITY OF, AND ALL STRESSES TO THE STRUCTURE DUE TO ANY CAUSE DURING CONSTRUCTION.

H. CONTRACTOR SHALL NOT SCALE DRAWINGS. CONTRACTOR SHALL REQUEST ALL DIMENSIONS OR INFORMATION REQUIRED TO PERFORM THE WORK FROM THE ARCHITECT. WORK COMPLETED BY THE CONTRACTOR WITHOUT DIMENSIONS OR INFORMATION SHALL BE DONE AT THEIR OWN RISK AND, IF DEEMED INCORRECT BY THE ARCHITECT, SHALL BE REMOVED AND REINSTALLED TO THE

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SPECIFICATIONS OF THE ARCHITECT AT NO ADDITIONAL COST TO THE OWNER.

I. CODES: THE PROJECT IS BASED ON THE REQUIREMENTS OF THE MASSACHUSETTS STATE BUILDING CODE - NINTH EDITION.

J. THE PLANS WERE COMPILED FROM VARIOUS SOURCES. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL EXISTING CONDITIONS AND DIMENSIONS.

K. FOR ALL ITEMS THAT ARE TO BE REUSED AND/OR REINSTALLED AS PART OF THE WORK:

ALL ITEMS THAT ARE TO REMAIN ARE TO BE PROTECTED FROM DAMAGE. IF ANY DAMAGE OCCURS THE CONTRACTOR SHALL REPAIR THE ITEM SO IT IS IN A LIKE NEW CONDITION OR REPLACE IT WITH A NEW ITEM THAT FUNCTIONS THE SAME OR BETTER THAN THE ORIGINAL ITEM.

ALL ITME THAT ARE TO BE TEMPORARILY REMOVED AND REINSTALLED ARE TO BE CAREFULLY REMOVED AND MOVED TO A PROTECTED AREA ON SITE OR TO AN OFF-SITE FACILITY. THE ITEM IS TO BE CLEANED AND PREPARED FOR REINSTALLATION. ALL FITTINGS AND CONNECTION POINTS ARE TO BE INSPECTED AND REPAIRED. PROVIDE NEW FASTENERS AND CAREFULLY TRANSPORT THE ITEM BACK TO ITS ORIGINAL LOCATION AND CAREFULLY REINSTALL. IF ANY DAMAGE OCCURS THE CONTRACTOR SHALL REPAIR THE ITEM SO ITI IS IN A LIKE NEW CONDITION OR REPLACE IT WITH A NEW ITEM THAT FUNCTIONS THE SAME OR BETTER THAN THE ORIGINAL ITEM.

3.15 INSURANCE

A. The Contractor shall purchase and maintain, at his expense all insurance required by the Contract. Documents and all insurance required by the applicable laws of Massachusetts, including but not limited to, General Laws, Chapter 146, in connection with all hoisting equipment.

B. The Contractor shall purchase and maintain such insurance as will protect him from claims under workmen's compensation acts and from claims for damages because of bodily injury, including death and all property damage including, without limitation, damage to buildings and adjoining the site of construction which might arise from and during operations under this contract, whether such operations be by himself or by any subcontractor or anyone directly or indirectly employed by either of them including:

1. Statutory Worker's Compensation and Employer's Liability

The contractor shall provide insurance for the payment of compensation and the furnishing of other benefits under Chapter 152 of the General Laws (so-

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called Worker's Compensation Act) to all persons to be employed under this contract and shall continue in force such insurance as aforesaid shall be deemed a material breach of this Contract and shall operate as an immediate termination thereof. The contractor shall, without limiting the generality of the foregoing, conform to the provisions of Section 34A of Chapter 149 of the General Laws, which Section is incorporated herein by reference and made a part of hereof.

2. Comprehensive General Liability Insurance

   Minimum bodily injury limits of $ 500,000 per person and $ 1,000,000 per accident, and property damage limits of $ 500,000 per accident and $ 1,000,000 aggregate during any 12 month period, shall include the following:

   a. Public liability (bodily injury and property damage)

   b. X.C.U. (explosion, collapse, and underground utilities)

   c. Independent contractor's protective liability.

   d. Products and completed operations.

   e. Save harmless agreement for Owner and Architects set forth in ARTICLE 10.11 of the GENERAL CONDITIONS.

3. Comprehensive All Risk Motor Vehicle Liability Insurance

   Minimum bodily injury limits of $ 500,000 per person, $ 1,000,000 per accident, and property damage limit of $ 1,000,000 per accident.

4. All Risk Insurance

   Covering all Contractor's equipment with a provision for Waiver of Subrogation against the Owner.

5. Excess Liability Insurance in Umbrella Form with combined Bodily Injury and Property Damage Limit of $ 1,000,000.

6. Town of Barnstable and CBI Consulting, LLC. shall be listed as Additional Insured with a Waiver of Subrogation on the insurance policy for this project.

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.03 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within five (5) days after review of preliminary schedule, submit draft of proposed complete schedule for review.

D. Within five (5) days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit the number of opaque reproductions that Contractor requires, plus one copy for the Owner's Project Manager and one copy that will be retained by Architect.

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1.04 SCHEDULE FORMAT

A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

B. Diagram Sheet Size: Maximum 22 x 17 inches or width required.

C. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Identify work of separate stages and other logically grouped activities.

D. Provide sub-schedules for each stage of Work identified in Section 01 10 00.

E. Provide sub-schedules to define critical portions of the entire schedule.

F. Include conferences and meetings in schedule.

G. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

H. Provide separate schedule of submittal dates for shop drawings, product data, and samples, Products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

I. Coordinate content with schedule of values specified in Section 01 20 00 - Price and Payment Procedures.

J. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.04 NETWORK ANALYSIS

A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.

B. Illustrate order and interdependence of activities and sequence of work; how start of agiven activity depends on completion of preceding activities, and how

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completion of the activity may restrain start of subsequent activities.

C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:

1. Preceding and following event numbers.
2. Activity description.
3. Estimated duration of activity, in maximum 15 day intervals.
4. Earliest start date.
5. Earliest finish date.
6. Actual start date.
7. Actual finish date.
8. Latest start date.
9. Latest finish date.
10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
11. Monetary value of activity, keyed to Schedule of Values.
12. Percentage of activity completed.
13. Responsibility.

D. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, accepting revised completion dates, and re-computation of all dates and float.

E. Required Reports: List activities in sorts or groups:

1. By preceding work item or event number from lowest to highest.
2. By amount of float, then in order of early start.

3.05 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within 5 days.

3.06 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

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C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

3.07 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 40 00 QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. Mock-ups.

B. Control of installation.

C. Tolerances.

D. Testing and inspection services.

E. Manufacturers' field services.

1.03 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittal procedures.

B. Section 01 42 16 - Definitions.

C. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.04 REFERENCE STANDARDS

A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).

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B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.

C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2013.

D. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.

E. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2013.

F. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2010.

1.05 SUBMITTALS

A. Testing Agency Qualifications:

1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time specialist and responsible officer.

2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design conceptexpressed in the contract documents, or for Owner's information.

C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.

1. Include:

a. Date issued.

b. Project title and number.

c. Name of inspector.

d. Date and time of sampling or inspection.

e. Identification of product and specifications section.

f. Location in the Project.

g. Type of test/inspection.

h. Date of test/inspection.

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i. Results of test/inspection.

j. Conformance with Contract Documents.

k. When requested by Architect, provide interpretation of results.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.

1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, andfinishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application orinstallation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.

1. Submit report in duplicate within 10 days of observation to Architect for information.

2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.06 PULL-OUT TESTS

A. The Contractor shall perform pull-out tests to determine the length and type of fastener required to provide adequate withdrawal resistance from every substrate.

B. A minimum of two (2) pull out tests shall be performed per section to be fastened. More tests shall be performed if required by the Architect or OPM or the material manufacturer.

C. Submit a report from the fastener supplier and the product manufacturer describing the pull out tests, the recommended fasteners, and that they are covered under themanufacturer's warranty.

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1.07 TESTING AND INSPECTION AGENCIES

A. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

C. Contractor Employed Agency:

1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1021, ASTM C1077, and ASTM C1093.

2. Laboratory: Authorized to operate in the State in which the Project is located.

3. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.

4. Testing Equipment: Calibrated at reasonable intervals either by NIST or using anNIST established Measurement Assurance Program, under a laboratory measurement quality assurance program

D. The Contractor shall cooperate with the inspector and/or testing laboratory, furnish materials and labor as may be required and provide for convenient access to all parts of the Work for purposes of inspection and testing.

E. The Contractor shall accept as final the results of all such inspection and testing.

F. The inspector and/or testing laboratory reserves the right to require the Contractor toperform removal of materials installed by the Contractor. Make all cuts in accordance with the recognized standard practices. Remove materials only in the presence of the inspector.

1. Immediately after removing each material sample identify each by number and exact location by gummed label attached to a smooth surface of the cut sample.

2. Submit the cut samples directly to the inspector after applying identification.

3. Replace the cut with new materials, matching those removed, immediately after each removal, and insure that the replacement is completely watertight.

G. The removal cuts shall be subjected to various tests, including moisture content, density, thickness, compressive strength, composition, conformance with ASTM specifications where applicable, conformance with the recommendations of the manufacturers whose materials were used.

H. Bear all costs for tests where materials or systems have been found unacceptable

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and all costs for replacement required due to such unacceptability.

I. If any replacement Work is required, such Work will also be subject to the terms of this Specification.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work, and will be required for each typical installation detail / condition by the General Bidder and each Filed Sub-Bidder.

B. Provide supervisory personnel who will oversee mockup construction. Provide workers that will be employed during the construction at Project.

C. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

D. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

E. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

F. Accepted mock-ups shall be a comparison standard for the remaining Work.

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G. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing required.

B. Testing Agency Duties:

1. Test samples of mixes submitted by Contractor.
2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
3. Perform specified sampling and testing of products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests and inspections required by Architect.
7. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:

1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.

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2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.

3. Provide incidental labor and facilities:

   a. To provide access to Work to be tested/inspected.

   b. To obtain and handle samples at the site or at source of Products to be tested/inspected.

   c. To facilitate tests/inspections.

   d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.

5. Employ services of an independent qualified testing laboratory and pay foradditional samples, tests, and inspections required by Contractor beyond specified requirements.

6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, as applicable, and toinitiate instructions when necessary.

B. Submit qualifications of observer to Architect 10 days in advance of required observations.

1. Observer subject to approval of Architect.

2. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

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END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 42 16 DEFINITIONS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SUMMARY

A. This section supplements the definitions contained in the General Conditions.

B. Other definitions are included in individual specification sections.

1.03 DEFINITIONS

A. "Consultant": Any reference to "Designer", "Engineer" or "Architect" in this Project Manual, Specification or on the drawings shall refer to CBI Consulting LLC, 250 Dorchester Avenue., Boston, Massachusetts 02127, (617) 268-8977, Steven Watchorn, Project Manager.

B. Furnish: To supply, deliver, unload, and inspect for damage. See also 01 10 00 Intent of the Project Manual.

C. "Owner": Any reference to the Owner shall be the Town of Barnstable.

D. "Owner's Project Manager": Any reference to Owner's Project Manager (OPM) in this Project Manual, Specification, or on the drawings shall refer to Mark Marinaccio, Project Architect for the Town of Barnstable Structures & Grounds.

E. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use. See also 01 10 00; 1.11 Intent of the Project Manual.

F. Product: Material, machinery, components, equipment, fixtures, and systems

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forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

G. Project Manual: The book-sized volume that includes the procurement requirements, the contracting requirements, and the specifications.

H. Provide: To furnish and install. See also 01 10 00; 1.11 Intent of the Project Manual.

I. Supply: Same as Furnish. See also 01 10 00; 1.11 Intent of the Project Manual.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary sanitary facilities.

D. Temporary Controls: Barriers, enclosures, and fencing.

E. Security requirements.

F. Vehicular access and parking.

G. Waste removal facilities and services.

H. Field offices.

1.03 GENERAL

A. The Contractor shall be responsible for providing and maintaining all temporary facilities until Substantial Completion. Removal of such prior to Substantial Completion must be with the concurrence of the Architect. The Contractor bears full responsibility for re-providing any facility removed prior to Substantial Completion.

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B. Removal of all temporary facilities shall be a condition precedent to SubstantialCompletion unless directed otherwise by the Architect or specifically noted in the Specifications.

C. The Contractor must comply with all safety laws and regulations of the Commonwealth of Massachusetts, the United States Government, and local government agencies applicable to Work under this Contract. The Contractor's attention is directed to the Commonwealth of Massachusetts, Department of Labor and Industries Regulation 454 CMR.

D. Safety is the sole responsibility of the Contractor on the job site. Contractor is notified that the building will be occupied by staff and administration during construction. The Architect does not havecontrol of the job site in any way.

1.04 TEMPORARY UTILITIES

A. Owner will provide the following:

1. Electrical power, consisting of connection to existing facilities, except for temporary heat.

2. Water supply, consisting of connection to existing facilities.

3. It is the responsibility of the Contractor to make provisions to extend the utility from the nearest service outlet designated by the Owner to the point of use.

B. If the Owner finds that the Contractor has been using excess quantities of water and electricity, the Owner will require the contractor to pay for all electrical power and water required for construction purposes, and to provide and pay for sub-meters to monitor the usage.

C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

D. The Contractor shall provide extensions, including (but not exclusive of) piping, hoses, and extension cords to existing utilities as required to perform the Work.

E. The Contractor shall provide an adequate supply of cool drinking water with individual drinking cups for personnel on the job.

1.05 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:

1. The Contractor shall provide a separate cell phone for the use of the Contractor's Project Superintendent.

2. The Contractor shall pay for the installation and removal of the foregoing temporary cell phone and for all calls and charges in connection therewith.

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3. No telephone service will be provided by the Owner.

4. All telephone numbers for the project team shall be available to the project team. Provide cell phone for the Project Superintendent at the job site.

5. Provide 24-hour emergency phone numbers for the Contractor's Project Manager and Superintendent.

6. Email: Account/address reserved for project use.

1.06 TEMPORARY SANITARY FACILITIES

A. Portable toilets shall be provided by the Contractor.

B. Use of the building's facilities by the Contractor shall not be permitted.

C. Protect the facilities from damage or vandalism.

D. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

E. Maintain Portable Toilets daily in clean and sanitary condition until Substantial Completion. Portable Toilets shall be emptied twice per week, minimum, and more often if required by the Owner. At Substantial Completion, professionally clean the site and return them to their original condition.

1.07 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of siteand to protect existing facilities and adjacent properties from damage from constructionoperations and demolition. This includes removing and storing all ladders and stagingfrom the site overnight to prevent access to the roof.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building. Such protective measures shall also be located and constructed as required by other local, state, and federal ordinances, laws, codes, or regulations.

C. Provide protection for plants and grass area. Replace damaged landscaping.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.08 FENCING

A. Provide minimum 6 foot high security fence around all storage areas, equipment storage areas, staging, and any areas providing access to above grade work areas. Equip all areas providing access to the fenced areas with vehicular and pedestrian lockable gates. Provide Construction site signage, as well.

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B. Site safety is the sole responsibility of the Contractor on the job site.

1.09 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.10 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from all Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Wood Framing and sheathing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.11 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Coordinate with Owner's security program.

C. Secure all tools and equipment at all times. Do not leave any tools or equipment in any areas where students can or will have access.

D. Security of the job site is the sole responsibility of the contractor.

1.12 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Designated existing on-site roads may be used for construction traffic.

F. Existing parking areas in locations indicated on the Site Plan, may be used for construction parking, subject to coordination with the Owner, and approval of the Site Utilization Plan.

G. Designate one parking space for Owner and Architect use.

1.13 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in

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clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable materialoutside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 FIELD OFFICES

A. The Owner will provide a space within the building for use by the Contractor as an office. Locations as directed by the Owner.

B. Weekly job meetings shall be held at the job site.

C. The offices, equipment, and furnishings shall be maintained by the **Contractor** in a clean and orderly condition.

1.15 TEMPORARY STAGING, STAIRS, CHUTES

A. Except as otherwise specified, the Contractor shall furnish, install, maintain in safe condition, and remove all scaffolds, staging, and planking over 8 ft. in height, required for the use of all trades for proper execution of the Work, except as noted.

B. The Contractor shall furnish, install, maintain in safe condition, and remove all temporary ramps, stairs, ladders, and similar items as required for the use of all trades for the proper execution of the Work.

C. The Contractor shall furnish, install, maintain, and remove covered chutes from the work area. Such shall be in convenient locations and permit disposal of rubbish directly into trucks or disposal units.

D. Debris shall not be allowed to fall freely from upper levels of the building. Materials shall not be thrown or dropped from open windows or the roof.

E. The General Bidder is responsible for erecting and maintaining, in safe condition, all scaffolding or staging required on the job, as well as all hoisting, to perform all the work in their scope, for the use of all Filed Sub-Bidders and Sub-Contractors, and for use by the Architect who will need to review the work or mark or verify quantities on the project.

F. Provide any and all additional protection required to keep the building from being damaged by the staging, hoisting, or any construction work. Protect parapets and roof edges with plywood at all swing staging. Protect landscaping from mechanical lifts, scaffolding, and all construction activities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

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END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. General product requirements.

B. Re-use of existing products.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations and procedures.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.03 SUBMITTALS

A. Refer to Section 01 30 00 for additional requirements.

B. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

1. Submit within 15 days after date of Agreement.

2. For products specified only by reference standards, list applicable reference standards.

C. Product Data Submittals: Submit manufacturer's standard published data. Mark

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each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project. The General Contractor shall include an electronic copy with all submittals.

D. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

D. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. DO NOT USE products having any of the following characteristics:

1. Made of wood from newly cut old growth timber.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a

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Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

C. A request for substitution constitutes a representation that the submitter:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance willrequire revision to the Contract Documents.

E. Substitution Submittal Procedure:

1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. The Architect will notify Contractor in writing of decision to accept or reject request.

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3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order tominimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

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K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.

C. Pre-installation meetings.

D. Cutting and patching.

E. Cleaning and protection.

F. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

G. General requirements for maintenance service.

1.03 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary of Work: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

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B. Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

C. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.

D. Section 01 50 00 - Temporary Facilities and Controls: Temporary exterior enclosures.

E. Section 01 50 00 - Temporary Facilities and Controls: Temporary interior partitions.

F. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.

G. Section 02 41 00 - Selective Demolition: Demolition of whole structures and parts thereof; site utility demolition.

1.04 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.

1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.

2. Identify demolition firm and submit qualifications.

3. Include a summary of safety procedures.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:

1. Structural integrity of any element of Project.

2. Integrity of weather exposed or moisture resistant element.

3. Efficiency, maintenance, or safety of any operational element.

4. Visual qualities of sight exposed elements.

5. Work of Owner or separate Contractor.

6. Include in request:

a. Identification of Project.

b. Location and description of affected work.

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c. Necessity for cutting or alteration.

d. Description of proposed work and products to be used.

e. Alternatives to cutting and patching.

f. Effect on work of Owner or separate Contractor.

g. Written permission of affected separate Contractor.

h. Date and time work will be executed.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.06 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.

1. Minimum of 5 years of documented experience.

B. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.07 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

C. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.

2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.

E. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

1. Pest Control Service: Weekly treatments.

F. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

G. Pollution Control: Provide methods, means, and facilities to prevent

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contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.08 COORDINATION

A. See Section 01 10 00 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependentconstruction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment arecompatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electricalwork that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building.Utilize spaces efficiently to maximize accessibility for other installations, formaintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, includingelements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:

1. Review conditions of examination, preparation and installation procedures.

2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 GENERAL INSTALLATION REQUIREMENTS

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A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity forreplacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

1. Verify that construction and utility arrangements are as shown.

2. Report discrepancies to Architect before disturbing existing installation.

3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.

1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.

2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.

1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.

2. Remove items indicated on drawings.

3. Relocate items indicated on drawings.

4. Where new surface finishes are to be applied to existing work, perform

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removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.

5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.

2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.

3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

a. Disable existing systems only to make switchovers and connections; minimize duration of outages.

b. Provide temporary connections as required to maintain existing systems in service.

4. Verify that abandoned services serve only abandoned facilities.

5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.

1. Prevent movement of structure; provide shoring and bracing if necessary.

2. Perform cutting to accomplish removals neatly and as specified for cutting new work.

3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.

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2. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:

1. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:

1. Complete the work.

2. Fit products together to integrate with other work.

3. Provide openings for penetration of mechanical, electrical, and other services.

4. Match work that has been cut to adjacent work.

5. Repair areas adjacent to cuts to required condition.

6. Repair new work damaged by subsequent work.

7. Remove samples of installed work for testing when requested.

8. Remove and replace defective and non-conforming work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

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G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. Patching:

1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

2. Match color, texture, and appearance.

3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

E. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1. Do not burn or bury rubbish and waste materials on the site.

2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

3. Do not dispose of wastes into streams or waterways.

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

G. Do not allow materials and rubbish to drop free or be thrown from upper floors, but remove by use of a material hoist or rubbish chutes.

H. Maintain the Site free from accumulations of waste, debris, and rubbish.

I. Provide on-site containers for collection of waste materials and rubbish.

J. At the end of each day, remove and legally dispose waste materials and rubbish from site.

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K. Disposal of materials shall be in compliance with all applicable laws, ordinances, codes, and by-laws.

3.08 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofingmaterial manufacturer.

G. Prohibit traffic from landscaped areas.

H. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.09 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.10 FINAL CLEANING

A. Prior to submitting a request to the Architect to certify Substantial Completion of the Work, the Contractor shall inspect all interior and exterior spaces and verify that all waste materials, rubbish, tools, equipment, machinery, and surplus materials have been removed, and that all sight-exposed surfaces are clean. Leave the Project clean and ready for occupancy.

B. Unless otherwise specified under other sections of the Specifications, the Contractor shall perform final cleaning operations as herein specified prior to final inspection.

C. Cleaning shall include all surfaces, interior and exterior, which the Contractor has had access to, whether new or existing.

D. Employ experienced workmen or professional cleaners for final cleaning.

E. Use only cleaning materials recommended by the manufacturer of the surface to be cleaned.

F. Use cleaning materials which will not create a hazard to health or property and which

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will not damage surfaces.

G. All broken or defective glass caused by the Contractor's Work shall be replaced at the expense of the Contractor.

H. Remove grease, mastic, adhesive, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior surfaces. This includes cleaning of the Work of all finishing trades where needed, whether or not cleaning by such trades is included in their respective specifications.

I. Clean and polish all new and existing glass and plastic glazing (if any) throughout the building(s), on both sides. Clean plastic glazing in accordance with the manufacturer's directions. This cleaning shall be completed by qualified window cleaners at the expense of the Contractor just prior to acceptance of the Work.

J. Wash and polish all mirrors.

K. Repair, patch, and touch up marred surfaces to the specified finish, to match adjacent surfaces.

L. Polish glossy surfaces to a clear shine.

M. Do the final cleaning of resilient floors and wood floors as specified under the respective sections of the Specifications.

N. Leave all architectural metals, hardware, and fixtures in undamaged, polished conditions.

O. Leave pipe and duct spaces, plenums, furred spaces and the like clean of debris and decayable materials.

P. In cleaning items with manufacturer's finish or items previously finished by a Subcontractor, care shall be taken not to damage such manufacturer's or Subcontractor's finish. In cleaning glass and finish surfaces, care shall be taken not to use detergents or other cleaning agents which may stain adjoining finish surfaces. Any damage to finishes caused by cleaning operations shall be repaired at the Contractor's expense.

Q. Broom clean exposed concrete surfaces and paved surfaces. Rake clean other surfaces of grounds.

R. Ventilating systems - Replace filters and clean ducts, blowers, and coils if units were operated during construction.

S. Owner's responsibility for cleaning commences at Substantial Completion.

3.11 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

1. Provide copies to Architect and Owner.

B. Accompany Project Coordinator on preliminary inspection to determine items

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to be listed for completion or correction in the Contractor's Correction Punch List forContractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completioninspection.

E. Owner will occupy all of the building as specified in Section 01 10 00.

F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Accompany Project Coordinator on Contractor's preliminary final inspection.

I. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

J. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.12 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specifiedwarranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 78 00 CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.03 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.04 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment. All submittals shall also be submitted in digital format.

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B. Operation and Maintenance Data:

1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

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D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.

3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Contractor shall maintain and record all changes to the plans throughout the entire project, in electronic AutoCAD and PDF format, prior to final payment. The Town and the Architect will provide existing AutoCAD base files for the sole purpose of the Contractor to generate the as-built drawings. Legibly mark each item to record actual construction including:

1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

2. Field changes of dimension and detail.

3. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:

1. Product data, with catalog number, size, composition, and color and texture designations.

2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

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C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation andmaintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:

1. Description of unit or system, and component parts.

2. Identify function, normal operating characteristics, and limiting conditions.

3. Include performance curves, with engineering data and tests.

4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation andmaintenance of the specific products.

C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

E. Provide servicing and lubrication schedule, and list of lubricants required.

F. Include manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specificationsections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

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C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

D. Prepare data in the form of an instructional manual.

E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

G. Project Directory: Title and address of Project; names, addresses, and telephonenumbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

H. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

I. Dividers: Provide tabbed dividers for each separate product and system; identify thecontents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

L. Arrangement of Contents: Organize each volume in parts as follows:

1. Project Directory.
2. Table of Contents, of all volumes, and of this volume.
3. Operation and Maintenance Data: Arranged by system, then by product category.
    a. Source data.
    b. Product data, shop drawings, and other submittals.
    c. Operation and maintenance data.
    d. Field quality control data.
    e. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item ofwork. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial

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completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. The General Contractor and all Filed Sub-Bidders shall each perform a one-year warranty inspection.

F. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

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DIVISION 02 EXISTING CONDITIONS

SECTION 02 41 00 SELECTIVE DEMOLITION

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect Work of this Section whether or not such Work is specifically mentioned in this Section.

C. Coordinate Work with that of all other trades affecting or affected by Work of this Section. Cooperate with such trades to assure the steady progress of all Work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the Work shall be new and of the best grade of their respective kinds.

1.02 WORK TO BE PERFORMED

A. Provide all the Demolition Work required to complete the Work of the Contract including all the Demolition Work shown on the plans, listed in the specification, and needed to install a complete assembly in every way. Coordinate the Demolition Work with all the other trades for the project. Provide all demolition and disposal Work to complete the Demolition Work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All Work of the Contract is related. It is the General Contractor's responsibility to review all the Work of each section, each Subcontractor, and each file sub-bidder for the entire project so that all the Work can be properly and completely performed.

B. Selective Demolition Work includes, but is not limited to:

1. In general, the Contractor shall supply all material, equipment, temporary protection, tools and appliances necessary for the proper removal of selected construction materials for the completion of the Work as required in the Specifications, in accordance with good construction, and as required by the materials manufacturer.

2. Supply all shoring and protection necessary to protect the occupants, building area, building systems, and landscape areas. All means and methods are the responsibility of the Contractor. The Contractor is solely responsible for safety on the job site.

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3. Extent of demolition as described on the drawings and in conjunction with all the new Work shown on the drawings. The Contractor is responsible for all demolition, disposal, and cleanup associated with the Work, whether or not shown on the plans or described herein required to complete the Work.

4. Selective Demolition Work by HVAC Filed Sub-Bidder:

   a. Remove and dispose of Rooftop Units #7 – 9 on the Library Roof. Coordinate extent of demolition of associated hot water piping, ductwork, controls, wiring, etc. with the Mechanical Drawings and Specifications.

   b. Remove and dispose of existing fin tube radiators at the base of all curtainwall assemblies inside the Library.

   c. Disconnect and remove all existing-to-remain ceiling supply air diffusers and return air grilles in ceilings scheduled to be removed, and reinstall existing diffusers and grilles after ceilings are re-installed.

   d. Remove and dispose of all diffusers and grilles in the 2-story high plaster ceiling scheduled to be demolished.

5. Selective Demolition Work by ELECTRICAL Filed Sub-Bidder:

   a. Remove and dispose of existing recessed lighting and paddle fans in the plaster ceiling of the 2-story Library in their entirety.

   b. Remove and dispose of existing lighting in Room H119-b. Install lighting and controls in Room H119-b as indicated on the Drawings.

   c. Remove and dispose of existing soffit light above the circulation desk.

   d. Remove and dispose of existing feeders, at rooftop units.

6. Selective Demolition Work by RESILIENT FLOORING Filed Sub-Bidder:

   a. Prepare existing concrete slab floor to receive new flooring as specified.

7. Selective Demolition Work by ACOUSTICAL TILE Filed Sub-Bidder:

   a. Carefully remove, store, and protect existing tectum and acoustical ceiling tiles and grid, to accommodate work above. Replace 10% of all ceiling tiles and grid removed with new to match existing.

8. Selective Demolition Work by GENERAL Bidder:

   a. Cut back PVC membrane roof at rooftop units to expose curb.

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b. Remove and dispose of low wood railing at the Stair and Mezzanine guardrail, including metal brackets. Grind metal post smooth at bracket locations.

c. Remove and dispose of all existing carpet flooring down to existing concrete slab floor, and remove and dispose of all rubber base at perimeter of carpet floors.

d. Remove and dispose of built-in wood circulation desk in its entirety.

e. Remove and dispose of VCT floor and rubber base in Room H210.

f. Remove and dispose of plastic grate soffit above circulation desk in its entirety.

g. Remove and dispose of existing plaster ceiling in the 2-story high space in its entirety.

h. Saw cut and remove existing concrete floor slab for under-slab power and data extensions. Coordinate final locations and extent with Electrical Contractor.

i. Remove gypsum wallboard under curtainwall on East wall of 2-story high space.

1.04 QUALITY ASSURANCE

A. Supervision:

1. Engage and assign supervision of shoring and bracing Work to qualified personnel.

B. Regulations:

1. Comply with local codes and ordinances of governing authorities having jurisdiction.

1.05 SUBMITTALS

A. Schedule:

1. Submit schedule indicating proposed methods and sequence of operations for Selective Demolition.

2. Include coordination for shut-off, capping, and continuation of utility services in scope area.

1.06 JOB CONDITIONS

A. Condition of Structures:

1. Owner assumes no responsibility for actual condition of items or structures to be demolished.

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2. Conditions existing at time of commencement of Contract will be maintained by Owner insofar as practicable.

B. Protections:

1. Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition Work. Safety is the sole responsibility of the Contractor.

2. Provide protective measures to provide free and safe passage of Owner's personnel and general public to and from area of selective demolition.

3. Erect temporary covered passageways as required by authorities having jurisdiction.

4. Take measures to protect against windblown dust, obtain Owner's approval of means used for dust control.

5. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished, and adjacent facilities or Work to remain.

6. Protect from damage existing finish Work that is to remain in place and becomes exposed during demolition operations.

7. Protect adjacent materials and finishes with suitable coverings when necessary including, but not limited to, automobiles in parking lot adjacent to building which will remain in use during Work to be performed.

8. Remove protections at completion of Work.

C. Damages: Promptly repair damages caused to building or property, including cars, by demolition Work at no cost to Owner.

D. Traffic:

1. Conduct Selective Demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

2. Do not close, block, or otherwise obstruct streets, walks, parking lot, or other occupied or used facilities without written permission from the authorities having jurisdiction.

3. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

E. Utility services:

1. Maintain existing utilities, keep in service, and protect against damage during demolition operations.

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2. Do not interrupt existing utilities service occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide 48 hours notice if service must be interrupted.

3. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

F. Environmental Controls:

1. Comply with governing regulations pertaining to environmental protection.

2. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.01 INSPECTION

A. Before start of Selective Demolition Work, inspect areas in which Work will be performed.

3.02 PREPARATION

A. Structure Safety:

1. Provide exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structures to be demolished and adjacent facilities to remain.

2. Cease operations and notify the Owner's Representative immediately if safety of structure appears to be endangered.

3. Take precautions to support structure until determination is made for continuing operations.

B. Shoring and Bracing

1. If shoring and bracing is required, locate the system to clear permanent construction and to permit the completion of the Work.

2. Provide shoring and bracing system adequately anchored and braced to resist natural forces.

3. No shoring and bracing system shall remain at the completion of the Work.

3.03 DEMOLITION

A. General:

1. Perform Demolition Work in a systematic manner.

2. Use such methods as required to complete Work indicated on Drawings in accordance with Demolition Schedule and governing regulations.

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3. If unanticipated mechanical, electrical, or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict with Consultant.

B. Disposal of Demolished Materials:

1. Remove debris, rubbish, and other materials resulting from demolition operations from site.

2. Transport and legally dispose of materials off site.

3. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution. Present receipts from certified waste disposal firms confirming hazardous waste disposal.

4. Burning of removed materials is not permitted on project site.

3.04 CLEANING AND REPAIR

A. On completion of demolition Work, remove tools, equipment, and demolished materials from site. Remove debris on a daily basis.

B. Remove protection and leave areas broom clean.

C. Repair demolition performed in excess of that required.

D. Repair adjacent construction or surfaces soiled or damaged by selective demolition Work.

END OF SECTION

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DIVISION 05 METALS

SECTION 05 50 00 MISCELLANEOUS METALS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 WORK TO BE PERFORMED

A. Provide all the Miscellaneous Metals work required to complete the work of the contract including all the Miscellaneous Metals work shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all reinforcing, pinning, and finishes. Coordinate the Miscellaneous Metals work with all the other trades for the project. Provide all demolition and disposal work to complete the Miscellaneous Metals work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All work of the contract is related. It is the General Contractor's responsibility to review all the work of each section, each sub-Contractor, and each file sub-bidder for the entire project so that all the work can be properly and completely performed.

B. Miscellaneous Metals work includes, but is not limited to:

1. Furnish and install new handrails and brackets at the existing stairs as shown on the Drawings.

2. Interior fabrications shall be prime painted and free of rust and scale.

1.03 SUBMITTALS

A. Submit complete shop drawings in accordance with the provisions of SECTION 01 31 00 - SUBMITTALS in GENERAL REQUIREMENTS.

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B. Do not commence fabrication of any work or begin installation until approval has been obtained from the Consultant.

1.04 STANDARDS AND CODES

A. The following Specifications, Standards and Codes of current issue form a part of this Specification.

B. American Society for Testing and Materials: A36, A48, A53, A123, A143, A149, A153, A246.

C. American Iron and Steel Institute, applicable standards.

D. American Institute for Steel Construction (AISC): Code of Standard Practice for Steel Buildings and Bridges: Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.

E. Federal Specs: QQ-1-652A, Iron Gray Castings; QQ-S741a, Steel Plates, Shapes and Bars, Carbon, Structural: WW-P521 Malleable Iron.

F. American Welding Society Code: Standard Code for Arc and Gas Welding in Building Construction.

G. National Association of Architectural Metal Manufacturers, applicable publications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All metals shall be free from defects impairing strength, durability or appearance and shall be of best commercial quality for each intended purpose.

B. Fastenings which are exposed shall be of same material, color and finish as the metal to which they are applied, unless otherwise shown on the Drawings, or specified. All items employed with galvanized iron and steel shall be hot-dipped color galvanized ferrous metal. All fastenings shall be of heavy gauge as customarily used in the trades to safely support the required loads.

C. Steel shapes shall conform to the requirements of ASTM A36 for Structural Steel. Steel pipe shall conform to ASTM A53.

D. Filler Metal for Welding: Welding electrodes for manual shielded metal arc welding shall conform to ASTM A233-58T, E60 or E70 Series. Bare electrodes and granular flux used in the submerged arc process shall conform to AISC Specifications.

E. Details and specifications of accessory items for which standard products are available are representative guides to requirements for such items. Standard products generally meeting such requirements will be accepted if details of construction and installation are approved by the Consultant.

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2.02 WELDING

A. Welding shall be continuous. Tack welding will not be permitted for finished work. All exposed welds shall be clean and ground smooth.

B. Where structural joints are made by welding, the details of all joints, the techniques of welding employed, the appearance and quality of welds made, and the methods used to correct defective work shall conform to AISC and AWS Codes.

C. Welds shall be made only by certified welders who have previously been qualified by tests as prescribed in AWS Standard Qualification Procedure for the type of work required.

D. The use of a gas cutting torch in the field for correcting fabrication errors will be permitted on structural framing members only when the prior written approval of the Consultant has been obtained for each specific condition.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. All work shall be executed by experienced mechanics and shall conform to details, be clean and straight with sharply defined profiles. Unless otherwise particularly noted, finished surfaces shall have smooth finish.

B. Shearing and punching shall be done cleanly so as not to deform or mar adjacent surface.

C. Shop connections shall be welded and field connections bolted unless otherwise indicated. Bolts shall be turned up tight and threads deformed to prevent loosening.

D. Castings shall be sound and free from warp, holes and other defects that impair strength and appearance. Exposed surfaces shall have a smooth finish with sharp well-defined lines and arises. Machined joints shall be milled to a close fit. Provide all necessary lugs, brackets and similar items so that work can be assembled and installed in a neat substantial manner.

E. Flanges shall be concealed where practicable. Thickness of metal and details of assembly and support shall be such as to provide ample strength and stiffness.

F. Provide holes and connections as required to accommodate work of other trades and for site assembly of metal work. Holes shall be drilled or punched and reamed in the shop. Show sizes and locations of all such holes on the shop drawings.

G. Joints and connections exposed to weather shall be formed to exclude water.

H. All materials and workmanship under this Section shall be subject to inspection in the mill, shop or field by the Consultant, or by qualified inspectors retained by the Owner. Inspection shall be without expense to the Owner. However, such

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inspection, wherever conducted, shall not relieve Contractor of his responsibility to furnish materials and workmanship in accordance with Contract requirements.

3.02 INSTALLATION

A. Take all required measurements at the building site. Check measurements, compare dimensions and other data with various trades installed adjoining work to assure proper coordination.

B. Conform to AISC Code for all drilling and fitting, cutting, welding, bolting and riveting required to erect, install and fit metal work to adjoining work. Furnish all screws, bolts, anchors, etc., required to attach metal work securely to adjoining work.

C. Do not cut or alter members in the field without Consultant's approval. Do not enlarge unfair holes by burning and forcing, but correct by reaming.

D. Be responsible for the correct location of miscellaneous metal work, including anchor bolts and base plates, and angles. Take particular care to maintain steel shapes, etc., plumb and level during the construction.

E. All work shall be accurately set to established lines and elevations and rigidly fastened in place with suitable attachments to the construction of the building.

F. Furnish, fabricate, install and anchor all light iron, miscellaneous metal work as indicated on the Drawings and as specified herein. Install all supports and anchors for miscellaneous metal work.

G. Furnish all required anchors, anchor bolts, fastenings, etc., for attachment of work of all trades to concrete and masonry, except where otherwise specified or obviously included under other Sections of the Specifications.

H. Clean up site of all debris, tools and materials daily.

3.03 PROTECTION

A. The Contractor is responsible for protecting the finish of the railings after coating during storage, delivery and installation.

B. Touch-up scrapes, scratches and any other mar in the finish after installation as per the specification.

C. If Consultant determines that the paint finish has been damaged by the Contractor, beyond repair by touch-up, the entire railing section shall be removed and taken back to the shop and re-finished as per the specification and at no additional cost to the Owner.

END OF SECTION

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DIVISION 06 WOOD, PLASTICS AND COMPOSITES

SECTION 06 10 00 ROUGH CARPENTRY

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 WORK TO BE PERFORMED

A. Provide all the Rough Carpentry work required to complete the work of the contract including all the Rough Carpentry work shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all reinforcing, pinning, and finishes. Coordinate the Rough Carpentry work with all the other trades for the project. Provide all demolition and disposal work to complete the Rough Carpentry work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All work of the contract is related. It is the General Contractor’s responsibility to review all the work of each section, each sub-contractor, and each file sub-bidder for the entire project so that all the work can be properly and completely performed.

B. Rough Carpentry work includes, but is not limited to:

1. All General Contractor's temporary work, including barricades, tarpaulins, protective covers, dust barriers, scaffolding, and entrances.

2. Installation of materials supplied under other specification sections, including but not limited to: Blocking, electrical backer boards.

3. Wood framing and blocking required to complete the work.

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1.03 QUALITY ASSURANCE

A. Softwood Lumber Standards: Provide lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's Board of Review.

B. Plywood Standards: Provide plywood to comply with PSI-74 "US Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PSI provisions, with American Plywood Association (APA) "Performance Standard and Policies for Structural Use Panels" and with ANSI A199.1.

C. Grade Stamps: Each piece of lumber and plywood delivered to job site shall have factory-market grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species and moisture content at time of surfacing, and mill.

D. Preservation treated lumber shall be marked according to AWPB Quality Mark Requirements, complying with AWPB LP-2.

1.04 PRODUCT HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood. Provide for air circulation within and around stacks and under temporary coverings.

1.05 JOB CONDITIONING

A. Time delivery and installations of carpentry work to avoid delaying other trades whose work is dependent on or affected by the carpentry work and to comply with protection and storage requirements.

B. Contractor must examine the substrates and supporting structures and the conditions under which the carpentry work is to be installed, and notify the Owner in writing of conditions until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

C. Coordinate location of furring, nailers, blocking, grounds, and similar supports so that attached work will comply with design requirements.

1.06 SUBMITTALS

A. Within thirty (30) days after Notice to Proceed, submit complete materials data and Shop Drawings in full compliance with Section 01 31 00.

B. Submit a complete list of all materials and products required to complete the work of this Section.

C. Submit full Product Data of all manufactured or proprietary items, and certification of compliance with these requirements for all items to be furnished exactly as specified.

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D. Submit Shop Drawings of all items to be fabricated off or on site as requested by the Consultant or required for proper coordination of the work. Shop Drawings may include detailed framing plans and elevation, bracing or connection details, sheathing layouts, schedules or diagrams of openings, and other information.

PART 2 – PRODUCTS

2.01 LUMBER, GENERAL

A. General Quality: Lumber shall be of new, sound stock, straight, or consistent size, free of stains, and mildew, and be surfaced on four sides. Lumber which will be incorporated into the finished work shall have a moisture content of not more than 19%.

B. Nominal sizes are indicated, except as shown by detailed dimensions. Provide dressed or worked and dressed lumber as applicable manufactured to the actual sizes as required by PS20 or to actual sizes and patterns as shown, unless otherwise indicated.

C. Lumber lengths: Lumber shall be furnished in longest particle lengths with respect to each intended use, and single length pieces shall be used whenever possible.

2.02 LUMBER, MATERIAL

A. Dimensional: "Concealed" Lumber

1. Temporary Framing: Provide "Standard" grade lumber, any species.

2. Concealed Boards, Blocking: Provide Southern Pine No. 2 or any species graded construction boards per WCLIB or WWPA rules. Concealed boards shall have maximum moisture content of 19%.

3. Plywood: Provide marine grade plywood panels in thickness indicated on the drawings or, if not otherwise indicated provide 3/4" thickness.

4. Preservative- treated Lumber shall be impregnated under pressure with water-borne preservative to comply with AWPA-U1. All treated wood shall be kiln-dried to a maximum moisture content of 19%. All field cuts shall be treated with compatible preservative materials.

B. Fasteners and Anchorages: Provide size, type material and finish as indicated and as recommended by applicable standards and the Massachusetts building Code. Where carpentry work is exposed to weather, or exterior surfaces are in contact with the ground, provide fasteners and anchorages with hot-dip zinc coating.

2.03 ROUGH HARDWARE

A. Fabricated hardware items shall be by Teco, Simpson, Heckman, or Silver as approved by the Consultant. In exterior areas or where in contact with concrete, rough hardware shall be hot-dip galvanized. In other areas electrogalvanizing will be acceptable. Select products for size of members joined or supported and to develop the full strength of the members.

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PART 3 – EXECUTION

3.01 INSTALLATION

A. Coordination: Fit carpentry work to other work; scribe, and cope for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

B. Defects: Discard lumber or other material with defects which might impair the quality of work.

C. General Execution: Construct all carpentry work called for in the Drawings or reasonably inferable therefrom. Set carpentry work to required levels and lines, with members plumb, level and true to line and cut and fitted. Shim as required using concealed shims. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Where nailing or power driving into concrete or masonry, take care to avoid puncturing conduits, pipes, ducts, etc. embedded in such work.

3.02 LAYING OUT WORK

A. The Contractor shall be responsible for establishing lines and levels in accordance with the conditions of the Contract and general requirements.

B. Lay out all work in accordance with the Contract Documents, approved Shop Drawings, and completed portions of the work. Report all discrepancies to the Consultant promptly for correction and adjustment. In the event of failure to do so, be responsible for correction of any errors.

3.03 MISCELLANEOUS BLOCKING AND CARPENTRY

A. Furring, blocking, and backing shall be furnished and installed where required for reception of wall board, formation of architectural features, concealment of pipes, conduits, ducts, attachment for supports for toilet room accessories, building specialties, and other fixtures. Contractor shall consult with the trades concerned and set furring and blocking they require.

B. Dressed wood grounds shall be furnished and installed as indicated or as required for securing trim or other finish. Set grounds rigid, true, and in perfect alignment. Nail grounds to wood members, and secure to concrete or masonry with nailing blocks or plugs, or expansion type anchors. Provide wood stripping where indicated or required for the attachment of finish materials to wood, concrete, masonry, or other surfaces.

3.04 INTENT AND WORKMANSHIP

A. It is not the intent of this Section to hereinafter define the types, sizes, or installation methods for each item of work. Methods of installation, joinery, sizes, spacing of nailers and furring strips, and other information pertaining to the lumber, plywood, and other items of required work, shall be installed in accordance with the details on the Drawings for the specified areas involved.

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B. Work that is to be finished or painted shall be free from defects or blemishes on surfaces exposed to view that will show after the finish coat of paint is applied. Any material which is in any way defective and not up to specifications for quality and grade for its intended use, or otherwise not in proper condition, shall be rejected.

END OF SECTION

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DIVISION 06 WOOD, PLASTICS AND COMPOSITES

SECTION 06 40 00 ARCHITECTURAL WOODWORK

PART 1-GENERAL

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect Work of this Section whether or not such Work is specifically mentioned in this Section.

C. Coordinate Work with that of all other trades affecting or affected by Work of this Section. Cooperate with such trades to assure the steady progress of all Work under Contract.

D. It is the intent of the Specifications and the Drawings to require that the materials and equipment to be furnished complete in every respect, and that this Contractor shall provide all items needed and usually furnished in connection with such systems to provide a complete installation. Equipment, materials, and articles incorporated in the Work shall be new and of the best grade of their respective kinds.

1.02 WORK TO BE PERFORMED

A. Provide all the Architectural Woodwork required to complete the Work of the Contract including all the Architectural Woodwork shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all hardware, finishes, and accessories. Coordinate the Architectural Woodwork with all the other trades for the project. Provide all demolition and disposal Work to complete the Architectural Woodwork. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All Work of the Contract is related. It is the General Contractor's responsibility to review all the Work of each section, and each Subcontractor for the entire project so that all the Work can be properly and completely performed.

B. Architectural Woodwork includes but is not limited to:

1. Wood guardrail extension to match size, profile, and finish of existing adjacent top rail.

E. No attempt is made in this Section to list all elements of architectural woodwork required on this project or to describe how each element will be installed. It is the responsibility of the Contractor to determine for itself the scope and nature of the work required for a complete installation from the information provided herein and in the Drawings.

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1.04 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 0142 00 - References. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM D 523-Standard Specification for Specular Gloss.
2. AWI (Architectural Woodwork institute) Quality Standards, Eighth Edition.
3. AWI Quality Certification Program.
4. FSC (Forest Stewardship Council): "FSC Certification Program"
5. APA Grades and Specifications.
6. National Lumber Grades Authority, American Lumber Standards, and Grading Rules and Standards of the various lumber associations whose species are being used, with grade-marks for same.
7. U.S. Department of Commerce Simplified Practice Recommendation R-1 6, for sizes and use classifications of lumber; and Product Standard (PS):
    a. PS-1 - Construction and Industrial Plywood Standard.
    b. PS-20 - American Softwood Lumber Standard.

1.05 SUBMITTALS

A. Submit the following under provisions of Section 0133 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, specifications, performance data, for each item furnished hereunder, including, but not limited to: Fastenings, adhesives, hardware, and accessories
    a. Installation instructions: Provide installation instructions and templates for hardware and field applied items.
    b. Provide additional information required for fillers and finish products: Include chemical, functional, and environmental characteristics, limitations and special application requirements. Identify available colors, shades, and gloss.
    c. Adhesives: Include certification of data indicating Volatile Organic Compound (VOC) content of all field-applied adhesives. Submit MSDS highlighting VOC limits. (MA-CHPS Credit IEQC 2.1).
    d. Recycled content: Provide manufacturer's written certification of recycled content. Indicate post-consumer and pre-consumer

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recycled content and provide documentation certifying products are from recycled sources. (MA-CHPS Credit MC 3).

e. Sealants: Include certification of data indicating Volatile Organic Compound (VOC) content of all joint sealants. Submit MSDS highlighting VOC limits. (MA-CHPS Credit IEQC 2.1).

2. Certifications: Wood products lacking acceptable documentation for the following will be rejected and their removal required.

a. Chain-of-Custody: Written documentation providing evidence of compliance with Chain-of-Custody supply of wood products, and compliance with FSC standards. (MA-CHPS Credit MC 3).

1. Demonstrate that products are FSC-certified by providing vendor invoices. Invoices will contain the vendor's chain of custody number and identify each chain of custody certified product on a line-item basis. A "vendor" is defined as the company that furnishes wood products to project contractors and/or subcontractors for on-site installation.

b. Urea-formaldehyde Resins: Written documentation certifying that all composite wood and agrifiber products used on this Project contain no added urea-formaldehyde. (MA-CHPS Credit IEQC 2.1).

1. Written certification from Millworker, that only "no added urea-formaldehyde" manufactured composite panel products are incorporated into the Work, including all concealed components. Composite panel products include but are not limited to particle board (PB), Medium Density Fiberboard (MDF) and similar manufactured products.

2. Written certification from Millworker that laminating adhesives used in product fabrication on or off site do not contain any added urea-formaldehyde resins.

3. Shop drawings bearing dimensions of actual measurements taken at the project, include at least the following, which are in addition to shop drawing requirements described in AWI Quality Standards:

a. Large scale design details of minimum 1-1/2 inch to 1-foot scale, showing abutting materials, installation conditions, clearances. Show woodwork profiles, jointing and fastening methods; details of drawers and doors.

b. Full size or half-full size sections, showing individual components, profiles and jointing.

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4. Verification samples:

   a. 12 inch long samples of solid hardwoods illustrating maximum range of color variations and applied transparent shop finish.

1.06 QUALITY ASSURANCE

A. Fabricator Installer: Work of this section shall be performed by a firm licensed by the AWI Quality Certification Program.

   1. Woodwork fabricator installer is required to be licensed by AWI as competent to perform the work specified. Certification shall be evidenced through the application of AWI Quality Certification labels and issuance of an AWI letter of licensing for the project. AWI certification labels shall be applied to each item of work.

   2. FSC (chain of custody) wood products are required to be installed by an installer having current FSC certification. Submit certification

B. Quality Standards: All work performed under this Section shall be of quality grades, indicated below, as defined in the referenced AWI 'Quality Standards, as modified herein by this Specification Section.

   1. All work having a transparent wood finish: Premium grade.

   2. All work having a opaque wood finish: Custom grade.

   3. All plastic laminated work: Custom grade.

C. Chain of Custody wood products: All wood products furnished under this Specification Section shall be "FSC certified" according to the rules of the Forest Stewardship Council (FSC).

   1. FSC Certification includes the following certification bodies of forests and forest products:

      a. Certification Systems.

      b. SmartWood.

      c. SGS Qualifor.

      d. Soil Association.

   2. Wood products lacking acceptable documentation for Chain of Custody, will be rejected and their removal required.

1.07 DELIVERY, STORAGE AND HANDLING

A. The woodwork manufacturer, woodwork installer and the Contractor are jointly responsible to make certain that woodwork is not delivered until the building and storage areas are sufficiently dry so that the woodwork will not be damaged by excessive changes in ambient humidity and relative moisture content.

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B. Concrete, masonry, plaster, tile and marble setting and polishing and other wet work shall be completed and dry before delivery, storage and installation of woodwork items.

C. Ship and handle all materials and fabricated items in a manner which will prevent damage thereto, and store all materials and fabricated items at a dry, elevated, ventilated, and protected interior location.

D. Sequence deliveries to avoid delays and to minimize on-site storage.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature above 55 degrees Fahrenheit for 5 calendar days before, and during installation of architectural woodwork; maintain temperature after installation until Owner's Final Acceptance.

B. Maintain a relative humidity between 25 and 55 percent for a minimum period of 5 calendar days before, and during, installation of architectural woodwork: maintain relative humidity after installation until Owner's Final Acceptance.

1.09 FIELD MEASUREMENTS

A. Field dimensions: The woodwork manufacturer is responsible for details and dimensions not controlled by Project conditions and shall show on his shop drawings all required field measurements beyond his control.

1. The Contractor shall acknowledge the woodwork fabricator's need for accurate field dimensions prior to custom fabrication.

2. The Contractor and the woodwork manufacturer shall cooperate to establish and maintain these field dimensions.

1.10 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with the respective trades responsible for installing interfacing work, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.

PART 2-PRODUCTS

2.01 LUMBER MATERIALS

A. General requirements: New, dressed four sides (S4S), and free from warping and other defects.

1. Moisture Content:

a. Solid hardwood(s) scheduled for transparent finish: Moisture content shall not exceed eight percent (8%) when delivered to Project.

b. Typical (hardwood and softwoods): Moisture content of wood shall be between five and ten percent (5 and 10%) when delivered to the project.

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B. Exposed wood scheduled for transparent finish (including but not limited to wood trim, casework frames, shelves, fillers, edge trim and drawer construction; and trim at wainscot): Red Oak (Quercus rubra), Quarter Sliced, AWI Grade I.

1. Wood shall color match specified veneer, and be clear without knots, and other natural defects.

2. Where indicated on Drawings, "Brosco" profile numbers are as distributed by Brockway Smith Co., Andover MA. Similar profiles by others will be considered by the Architect.

C. Exposed wood scheduled for opaque finish: White Birch, plain sliced, meeting AWI Grade I. Additionally, wood shall be clear without knots, and other natural defects.

2.06 ACCESSORIES

A. Adhesive for installation of plastic laminate: Rigid bond Polyvinyl acetate (PVA) type only.

Contact cements are only permitted at countertops with sinks or similar "wet condition" areas.

B. Glue for lamination and fabrication of wood and plywood items: Exterior Grade, phenolic resin glue.

C. Bolts, nuts, washers, lags, pins, and screws: Of size and type to suit application chrome finish in exposed-to-view locations.

1. Concealed joint fasteners: Threaded steel.

2.07 FABRICATION - GENERAL

A. Do not fabricate materials until all specified submittals have been submitted to, and approved by, the Architect.

B. Coordinate the fabrication of casework with that of the various trades responsible for installing materials and items which will be inserted into, or applied to, the casework surfaces. Obtain and verify templates, dimensions, and instructions from the respective trades before making cut-outs, holes. slots, and other cutting in the casework.

C. Shop assemble custom casework for delivery to site. Deliver in assemblies as large as possible for entrance into the designated areas. Provide for concealed job connections of adjacent units.

D. Fabricate, install and finish all work so that both sides of countertops, panels, doors, shelves and other casework are of balanced construction, to prevent warping.

E. Cap exposed plywood with solid hardwood, matching color *of* wood veneer panels. Apply veneer over hardwood edging in manner to show no visible lines between wood veneer and hardwood edging.

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F. Fit corners and joints hairline, secure with concealed fasteners.

G. Finish all solid wood and plywood surfaces smooth, and free from all machine and tool marks that will show through the wood veneer or facing materials.

H. Make all joints tight, and form to conceal shrinkage. Glue all miters having a dimension of 4 inches or more from heel to point.

I. Provide shop fabricated counters, shop mitered components, closure trims with ample allowance for field cutting and fitting. Provide additional trim as required for scribing and site cutting.

J. Finished work shall be free from visible adhesive and pencil marks.

2.10 SHOP APPLIED FINISHING

A. Transparent exposed-to-view finish for casework: AWI Premium Grade Factory Finish System N° TR-4 "Conversion Varnish" system having a Medium rubbed effect with a sheen of 24° to 28° gloss units per ASTM D523. Finish system shall not substantially increase flame spread.

1. One washcoat, reduced conversion varnish.

2. Colorant: None - natural finish.

3. One coat sealer, conversion varnish.

4. Two coats topcoat: Conversion varnish equal to Sherwin Williams product "V84 series Kern Var".

B. Concealed surfaces: Thoroughly coat all concealed surfaces of finish woodwork before assembling with two coats of clear wood preservative.

C. Field Touch-up: Shall be the responsibility of the installing contractor and shall include the filling, and touch-up of exposed job made nail or screw holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and marks, and final cleaning up of the finished surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verity adequacy of blocking, backing and support framing for all finish carpentry work.

B. Examine pre-fabricated woodwork before installation and verity that back priming has been completed and all packing has been removed.

C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

A. Before installing work under this section, woodwork shall be conditioned to average prevailing humidity conditions in areas of installation.

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3.03 INSTALLATION - GENERAL

A. Install work in accordance with the specified AWI quality standards.

B. Woodwork shall be installed plumb, level, true and straight without distortions.

1. Use concealed shims as required

2. Work shall be installed to a tolerance of 1/8 inch in 8 feet for plumb and levelness, including tops.

3. There shall be no variations in flushness of adjoining surfaces.

C. Tops and woodwork shall be scribed and trimmed to fit adjoining work.

1. Where cuts occur, refinish surfaces and repair damaged finishes

D. Secure woodwork to anchors or built-in blocking or blocking directly attached to substrates.

1. Secure woodwork to grounds, furring, stripping and blocking as required with countersunk, concealed fasteners and blind nailing performing a complete installation.

2. Use thin gauge finishing nails for exposed nailing, countersunk and filled flush with woodwork finished surface.

a. Match final finish materials where transparent finish is indicated.

3.05 FIELD FINISHING

A. Except where expressly noted otherwise on Drawings, shop finish all woodwork. Where field finishing is indicated or scheduled on Drawings, finishing Work shall be as specified under Section D9910- PAINTS.

3.06 TOLERANCES

A. Maximum variation from true position 1116 inch with a maximum of 1/32 inch offset from true alignment with adjoining surfaces intended to be flush.

3.07 ADJUSTING

A. To whatever extent work was not completed at shop or prior to installation of woodwork, perform and complete the specified finishing of woodwork.

B. Repair damaged and defective woodwork where possible eliminating defects functionally and visually.

1. Where not possible to repair damaged or defective work, replace with matching new work.

2. Adjust joinery for uniform appearance.

C. Adjust doors and drawers for smooth and balanced movement, lubricate hardware for use.

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3.08 CLEANING

A. Comply with requirements of Section 0174 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL for handling and disposition of all construction and demolition waste.

B. Daily clean work areas by sweeping and disposing of scraps and sawdust.

C. Upon completion of the work of this Section in any given area, remove tools, equipment and all rubbish and debris from the work area leave area in broom-clean condition.

D. Clean excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

E. Remove protective material from pre-finished surfaces, immediately prior to Final Acceptance.

F. Carefully clean exposed and semi-exposed wood surfaces, in strict accordance with fabricator's instructions. Touch-up shop-applied finishes to restore damaged or soiled areas, matching adjoining finish.

G. Wash down plastic laminate with a solution of mild detergent in warm water, applied with soft clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

H. Clean and polish hardware, and bright metal trim components.

3.09 PROTECTION

A. Protect installed woodwork and maintain specified conditions, in a manner acceptable to both fabricator and installer. Ensure that work of this Section will not be damaged or soiled, and is completely free of defects at the time of final acceptance of Project by the Architect.

END OF SECTION

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DIVISION 07 THERMAL AND MOISTURE PROTECTION

SECTION 07 54 40 PVC MEMBRANE REPAIR WORK

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 WORK TO BE PERFORMED

A. Provide all the PVC Membrane Repair Work required to complete the work of the contract including all the Membrane Repair Work shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all hardware, finishes, and accessories. Coordinate the Membrane Repair Work with all the other trades for the project. Provide all demolition and disposal work to complete the Membrane Repair Work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All work of the contract is related. It is the General Contractor's responsibility to review all the work of each section, each Subcontractor, and each file sub-bidder for the entire project so that all the work can be properly and completely performed.

B. Provide all the PVC Single Ply Roofing work required to complete the work of membrane repairs that includes but is not limited to:

1. Replacement of the existing PVC rooftop unit curbs with Sarnaclad flashing and Sarnafil membrane flashing.

2. At the conclusion of all work on the building under this contract, inspect the entire roof and make repairs to any holes, tears and loose seams in the PVC membrane sheet and edge flashings, where or not incurred from the work.

3. All repairs shall be made by a Sarnafil Approved Applicator.

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1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All products delivered to the job site shall be in the original unopened containers or wrappings bearing all seals and approvals.

B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.

C. All adhesives shall be stored at temperatures between 40° F (5° C) and 80° F (27° C).

D. All flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.

E. All materials which are determined to be damaged by the Owner's Representative or Sarnafil are to be removed from the job site and replaced at no cost to the Owner.

1.04 JOB CONDITIONS

A. Sarnafil materials may be installed under certain adverse weather conditions but only after consultation with Sarnafil, as installation time and system integrity may be affected.

B. Only as much of the new repair work as can be made weathertight each day, including all flashing and detail work, shall be installed. All seams shall be cleaned and heat welded before leaving the job site that day.

C. All work shall be scheduled and executed without exposing the interior building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.

D. Prior to and during application, all dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air and/or similar methods.

E. The Applicator shall follow all safety regulations as required by OSHA and any other applicable authority having jurisdiction.

F. All new roofing waste material (i.e., scrap roof membrane, empty cans of adhesive) shall be immediately removed from the site by the Applicator and properly transported to a legal dumping area authorized to receive such material.

G. Flammable adhesives shall not be stored and not be used in the vicinity of open flames, sparks and excessive heat.

H. Applicator shall immediately stop work if any unusual or concealed condition is discovered and shall immediately notify Owner of such condition in writing for correction at the Owner's expense (letter copy to Sarnafil).

I. Site cleanup, including both interior and exterior building areas which have been affected by construction, shall be completed to the Owner's satisfaction.

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J. Precautions shall be taken when using Sarnacol adhesives at or near rooftop vents or air intakes. Adhesive odors could enter the building. Coordinate the operation of vents and air intakes in such a manner as to avoid the intake of adhesive odor while ventilating the building. Keep lids on unused cans at all times.

K. Protective wear shall be worn when using solvents or adhesives or as required by job conditions.

1.05 SUBMITTALS

A. Product Data

1. Submit manufacturer's product data for all products to be used.

2. Submit Certification that the roofer is a Sarnafil Approved Applicator.

1.06 Warranty

A. The Roofer shall submit a two (2) year warranty for the repair work, that the repairs shall function as well as the existing roofing membrane that they are bonded too.

PART 2 PRODUCTS

2.01 MEMBRANE

A. Sarnafil® G410 fiberglass reinforced membrane with a lacquer coating.

B. Membrane shall conform to ASTM D4434 (latest revision), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II, Grade I.

C. As manufactured, membrane shall conform to the following physical properties:

1. Color to be white.

2. Thickness to be .060".

Parameters	ASTM Test Method	Minimum ASTM Requirement	Sarnafil Typical Physical Properties
Reinforcing Material	-		Fiberglass
Overall Thickness, min., inches (mm)	D638	0.060 (1.52)	0.060 (1.60)
Tensile Strength, min., psi (MPa)	D638	1500 (10.4)	1600 (11.1)
Elongation at Break, min. (machine x transverse)	D638	250% / 230%	270% / 250%
Seam strength, min. (% of tensile strength)	D638	75	80
Retention of Properties After Heat Aging	D3045	-	-
Tensile Strength, min., (% of original)	D638	90	95
Elongation, min., (% of original)	D751	90	90
Tearing Resistance, min., lbf (N)	D1004	10 (45)	14 (63)

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Low Temperature Bend, -40º F (-40º C)	D2136	Pass	Pass
Accelerated Weathering Test (Xenon Arc)	D2565	5,000 Hours	10,000 Hours
Cracking (7x magnification)	-	None	None
Discoloration (by observation)	-	Negligible	Negligible
Crazing (7 x magnification)	-	None	None
Linear Dimensional Change, max.	D1204	0.10 %	0.02%
Weight Change After Immersion in Water, max.	D570	± 3.0%	2.5%
Static Puncture Resistance, 33 lbf (15 kg)	D5602	Pass	Pass
Dynamic Puncture Resistance, 7.3 ft-lbf (10 J)	D5635	Pass	Pass

*Failure occurs through membrane rupture not seam failure.

2.02 FLASHING MATERIALS

A. Wall/Curb Flashing

1. Sarnafil G410 Membrane - A fiberglass reinforced membrane adhered to approved substrate using Sarnacol adhesive. Consult Sarnafil Product Data Sheets for adhesive options and additional information.

2. Sarnafil G459 Membrane - An asphalt-resistant, fiberglass reinforced membrane adhered to approved substrate using Sarnacol adhesive. Consult Sarnafil Product Data Sheet for adhesive rates and additional information.

3. Sarnaclad - A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Sarnaclad is a 25 gauge, G90 galvanized metal sheet with a 20 mil (1 mm) unsupported Sarnafil membrane laminated on one side. The dimensions of Sarnaclad are 4 ft x 8 ft (1.2 m x 2.4 m) or 4 ft x 10 ft (1.2 m x 3.0m). Consult Sarnafil Product Data Sheet for additional information.

C. Miscellaneous Flashing

1. Sarnastack - A prefabricated vent pipe flashing made from 0.048-inch (48 mil/1.2 mm) thick Sarnafil G410 membrane. Available in five different sizes. Consult Sarnafil Product Data Sheet for sizes and additional information.

2. Sarnacircle-"G" - Circular 0.048-inch (48 mil/1.2 mm) thick G410 membrane patch welded over T-joints formed by overlapping thick membranes.

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3. Sarnafiller - A urethane sealant used for pitch pocket topping. Sarnafiller is a two-component sealant. Sarnafiller cures with excellent elasticity and adhesion to various surfaces. Consult Sarnafil Product Data Sheet for additional information.

4. Sarnacorner - Prefabricated outside and inside flashing corners made of 0.060-inch (60 mil/1.5 mm) thick membrane that are heat-welded to membrane or Sarnaclad base flashings. Sarnacorner is available in 2 outside sizes (5 inch and 8-1/2 inch diameter/127 mm and 215 mm) and 1 inside size. Consult Sarnafil Product Data Sheet for additional information.

5. Sarnacol 2170 Adhesive - A solvent-based reactivating-type adhesive used to attach the membrane to the flashing substrate. Consult Product Data Sheets for additional information.

6. Sarnafelt - A non-woven polyester or polypropylene mat cushion layer that is necessary behind G410 or G459 Flashing Membrane when the flashing substrates are rough-surfaced or incompatible with the flashing membrane. Consult Product Data Sheets for additional information.

PART 3 EXECUTION

3.01 SUBSTRATE CONDITION

A. Applicator shall verify that the work done under related sections meets the following conditions:

1. Roof drains and/or scuppers have been reconditioned and/or working properly. Notify the Owner's Representative of problem drains for resolution.

2. Roof curbs, nailers, equipment supports, vents and other roof penetrations are properly secured and prepared to receive new roofing materials.

3. All surfaces are smooth and free of dirt, debris and incompatible materials.

4. All roof surfaces shall be free of water, ice and snow.

3.02 SUBSTRATE PREPARATION

A. The roof deck and existing roof construction must be structurally sound to provide support for the new roof system. Notify the Owner's Representative of potentially unsound conditions if found for resolution.

3.03 SUBSTRATE INSPECTION

A. A dry, clean and smooth substrate shall be prepared to receive the Sarnafil Adhered roof system.

B. The Applicator shall inspect the substrate for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect the quality of work.

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C. The substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until all defects have been corrected.

D. All roof surfaces shall be free of water, ice and snow.

E. Sarnafil repairs shall be applied over compatible and accepted substrates only.

3.04 MEMBRANE PREPARATION

A. Clean the existing Sarnafil membrane of heavy dirt in the areas of welding with household liquid soap and water using clean, soft cotton rags or cotton mops. Or power wash area to be cleaned. Do not use abrasive cleaners.

B. Remove remaining dirt using Methyl Ethyl Ketone (MEK) applied to a clean soft rag. Wipe the rag thoroughly over the area until the Sarnafil membrane is clean. Use proper precautions when handling MEK. MEK should not be poured directly on the Sarnafil membrane, and any spills should be wiped immediately.

C. Cut out patches allowing 4" overlap on each side of hole, or use Sarna circles at small tears and holes.

3.05 HOT-AIR WELDING PATCHES

A. General

1. All seams shall be hot-air welded. Seam overlaps should be 3 inches (75 mm) wide when automatic machine-welding and 4 inches (100 mm) wide when hand-welding.

2. Welding equipment shall be provided by or approved by Sarnafil. All mechanics intending to use the equipment shall have successfully completed a training course provided by a Sarnafil Technical Representative prior to welding.

3. All membrane to be welded shall be clean and dry.

B. Hand-Welding

Hand-welded seams shall be completed in two stages. Hot-air welding equipment shall be allowed to warm up for at least one minute prior to welding.

1. The back edge of the seam shall be welded with a narrow but continuous weld to prevent loss of hot air during the final welding.

2. The nozzle shall be inserted into the seam at a 45-degree angle to the edge of the membrane. Once the proper welding temperature has been reached and the membrane begins to "flow," the hand roller is positioned perpendicular to the nozzle and pressed lightly. For straight seams, the 1-1/2 inch (40 mm) wide nozzle is recommended for use. For corners and compound connections, the 3/4 inch (20 mm) wide nozzle shall be used.

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C. Machine Welding

1. Machine welded seams are achieved by the use of Sarnafil's automatic welding equipment. When using this equipment, Sarnafil's instructions shall be followed and local codes for electric supply, grounding and over current protection observed. Dedicated circuit house power or a dedicated portable generator is recommended. No other equipment shall be operated off the generator.

2. Metal tracks may be used over the deck membrane and under the machine welder to minimize or eliminate wrinkles.

D. Quality Control of Welds

1. The Applicator shall check all welded seams for continuity using a rounded screwdriver. Visible evidence that welding is proceeding correctly is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of dark gray material from the underside of the top membrane. On-site evaluation of welded seams shall be made daily by the Applicator to locations as directed by the Owner's Representative or Sarnafil's representative. One-inch (25 mm) wide cross-section samples of welded seams shall be taken at least three times a day. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut shall be patched by the Applicator at no extra cost to the Owner.

3.06 COMPLETION

A. Prior to demobilization from the site, the work shall be reviewed by the Owner's Representative and the Applicator. All defects noted and non-compliance with the Specifications or the recommendations of Sarnafil shall be itemized in a punch list. These items must be corrected immediately by the Applicator to the satisfaction of the Owner's Representative and Sarnafil prior to demobilization.

END OF SECTION

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DIVISION 09 FINISHES

SECTION 09 25 50 GYPSUM BOARD ASSEMBLIES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01000 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

1.02 WORK TO BE PERFORMED

A. Provide all the Gypsum Board Assemblies work required to complete the work of the contract including all the Gypsum Board Assemblies work shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all reinforcing, pinning, and finishes. Coordinate the Gypsum Board Assemblies work with all the other trades for the project. Provide all demolition and disposal work to complete the Gypsum Board Assemblies work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All work of the contract is related. It is the General Contractor's responsibility to review all the work of each section, each sub-contractor, and each file sub-bidder for the entire project so that all the work can be properly and completely performed.

B. Gypsum Board Assemblies work includes, but is not limited to:

1. Install gypsum wallboard (GWB) which shall be taped, spackled, and sanded at all board.

2. Provide 3½" fiberglass sound attenuation batt insulation at all stud partitions.

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1.04 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.05 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division01000 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings showing locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

D. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.06 QUALITY ASSURANCE

A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.

B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.08 PROJECT CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.

B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours before

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application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

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

1. Steel Framing and Furring:
   a. Clark Steel Framing, Inc.
   b. Dale Industries, Inc.
   c. Marino/Ware (formerly Marino Industries Corp.).
   d. Unimast, Inc.
2. Gypsum Board and Related Products:
   a. Domtar Gypsum.
   b. Georgia-Pacific Corp.
   c. National Gypsum Co.; Gold Bond Building Products Division.
   d. United States Gypsum Co.

2.02 STEEL FRAMING FOR WALLS AND PARTITIONS

A. Steel framing: Comply with requirements of Division 05000, Section 05400, Cold-Formed Metal Framing.

2.03 GYPSUM BOARD PRODUCTS

A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.

1. Widths: Provide gypsum board in widths of 48 inches (1219 mm).

B. Gypsum Wallboard: ASTM C 36 and as follows:

1. Thickness: 5/8 inch standard, in all areas outside baths.
2. Thickness: 5/8 inch Type – X fire rated at all one and two hour rated partitions.

2.04 JOINT TREATMENT MATERIALS

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A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

2.05 INSULATION

A. Provide 3½" fiberglass sound attenuation batt insulation at all stud partitions. Insulation shall comply with ASTM C 665, Type I and ASTM E 136.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

1. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

3.03 INSTALLING STEEL FRAMING, GENERAL

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.

1. Where building structure abuts ceiling perimeter or penetrates ceiling.

2. Where partition framing and wall furring abut structure, except at floor.

a. Provide slip- or cushioned-type joints as detailed to attain lateral support and avoid axial loading.

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b. Install deflection track top runner to attain lateral support and avoid axial loading.

c. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.

1) Attach jamb studs at openings to tracks using manufacturer's standard stud clip.

D. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.04 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.

2. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.

D. Terminate partition framing at suspended ceilings where indicated.

E. Install steel studs and furring in sizes and at spacings indicated.

F. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.

G. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

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1. Install 2 studs at each jamb, unless otherwise indicated.
2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint.
3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

I. Install thermal insulation as follows:

1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches (610 mm) 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 (600 mm) 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. Start from this furring channel with standard width insulation panel and continue in regular manner. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.
4. Until gypsum board is installed, hold insulation in place with 10-inch (250-mm) staples fabricated from 0.0625-inch (1.6-mm) diameter tie wire and inserted through slot in web of member.

J. Install polyethylene vapor retarder where indicated to comply with the following requirements:

1. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with mechanical fasteners or adhesives. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose mineral-fiber insulation.
2. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end, and bottom edges, at perimeter of wall openings, and at lap joints; space fasteners 16 inches (400 mm) o.c.
3. Seal joints in vapor retarders caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor retarder tape.
4. Repair any tears or punctures in vapor retarder immediately before concealing it with the installation of gypsum board or other construction.

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3.05 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

B. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate both edge or 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. Avoid joints other than control joints at corners of framed openings where possible.

E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

F. Attach gypsum panels to framing provided at openings and cutouts.

G. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches (813 mm) wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.

H. Form control and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.

1. Except where 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. (0.7 sq. m) in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

J. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide ¼ inch to ½ inch (6.4 mm to 12.7 mm) wide spaces at these locations and trim edges with U-bead edge trim where

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edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.

L. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

N. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.06 GYPSUM BOARD APPLICATION METHODS

A. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and gypsum wallboard 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. Stagger joints on opposite sides of partitions.

1. 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.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:

1. Fasten with screws.

2. Fasten to wood supports with adhesive and supplementary nails or screws.

3.07 INSTALLING TRIM ACCESSORIES

A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.

B. Install corner bead at external corners.

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C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.

1. Install L-bead where edge trim can only be installed after gypsum panels are installed.

2. Install U-bead where indicated.

D. Install control joints at locations indicated.

3.08 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, flanges of corner bead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.

C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.

D. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.

E. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.

F. Use the following joint compound combination as applicable to the finish levels specified:

1. Embedding and First Coat: Setting-type joint compound. Fill (Second) Coat: Setting-type joint compound. Finish (Third) Coat: Sandable, setting-type joint compound.

3.09 INSULATION

A. Fiberglass sound attenuation batt insulation shall be installed loose by friction fit. Cut long enough to fill entire void between and at ends of studs. Fill any gaps and holes with small pieces of insulation. Do not crush. Carefully fit around light fixtures and junction boxes.

3.10 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

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DIVISION 09 FINISHES

SECTION 09 51 23 ACOUSTICAL CEILINGS

Filed Sub-Bid Required (Acoustical Tile)

PART 1 - GENERAL

1.00 FILED SUB-BIDS

A. Acoustical Tile is stipulated as a Filed Sub-Bid under Part B, Item 2, of the FORM FOR GENERAL BID.

B. All sub-bids shall be submitted on the FORM FOR SUB-BID furnished by the Awarding Authority as required by Section 44G of Chapter 149 of the General Laws, as amended.

C. Sub-bids must be filed with the Awarding Authority in a sealed envelope, before the time stipulated in the ADVERTISEMENT, on the date stipulated in the ADVERTISEMENT.

D. Specific information relating to sub-bidders is set forth in the CONTRACT DOCUMENTS under the heading, "NOTICE TO ALL BIDDERS", and the attention of the sub-bidders is directed thereto.

E. The work to be done under this Section 09 51 23 is described herein, and on Drawings L1-01, D1-01 – D1-02, D2-01 – D2-02, A1-01 – A1-03, A2-01 – A2-02, A6-01 – A6-05, A9-01 – A9-03, FP0 – FP2, MD-1 – MD-3, M-1 – M-7, VS-1 – VS-2, E0.01, ED1.01 – ED1.02, E1.01 – E1.02, E2.01 – 03.

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

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1.02 WORK TO BE PERFORMED

A. Provide all the Acoustical Ceilings work required to complete the work of the contract including all the Acoustical Ceilings work shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all reinforcing, pinning, and finishes. Coordinate the Acoustical Ceilings work with all the other trades for the project. Provide all demolition and disposal work to complete the Acoustical Ceilings work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All work of the contract is related. It is the General Contractor's responsibility to review all the work of each section, each sub-contractor, and each file sub-bidder for the entire project so that all the work can be properly and completely performed.

B. Acoustical Ceilings work includes, but is not limited to:

1. Where indicated on the Drawings, install new 2' x 2' acoustical tile ceiling in exposed 'T' grid.

1.04 STANDARDS

A. Tolerances:

1. Surfaces to receive acoustical treatment: Free from irregularities and level to within 1/4", 12'.

2. Deflections:

a. Suspension system components, hangers, and fastening devices supporting light fixtures, ceiling grilles, and acoustical units: maximum defection 1/360 of the span.

b. Deflection test: ASTM C635.

3. Allowable tolerance of finished acoustical ceiling system: Level within 1/8", 12'.

4. Accessibility percentage: Set forth access requirements.

1.05 SUBMITTALS

A. Samples:

1. Submit representative full size samples of each type of acoustical material to illustrate color and range of appearance.

2. Submit one full size sample of each suspension system member, moldings, and hangers.

3. Submit one sample of pad and pad spacers for metal pan and perforated board tiles.

B. Shop Drawings:

1. Layout indication.

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2. Insert and hanger spacing and fastening details.
3. Splicing method for main and cross runners.
4. Change in level details.
5. Access door dimensions and locations.
6. Acoustical unit support at ceiling fixture.

C. Manufacturer's Literature: Submit for review of Architect/Engineer the manufacturer's recommendations for installation of suspension system.

D. Certificates:

1. Furnish certification of fire endurance rating and flame spread index of fire rating organization.
2. Furnish certification of materials and systems conforming to Specifications requirements.

E. Maintenance Material:

1. Furnish extra materials equal to 10% of each type of acoustical material supplied.
2. Furnish suspension system components in amount sufficient to install extra ceiling units.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original unopened protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness, and fire rating as applicable, legible and intact.

B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.

C. Store cartons open at each end to stabilize moisture content and temperature.

D. Do not begin installation until sufficient materials are received to complete a room.

PART 2 – MATERIALS

2.01 MATERIALS

A. Suspension Systems:

1. System: Exposed Tee Grid, Prelude XL 15/16”, by Armstrong or approved equal.
2. Main, cross and concealed members:
   a. Web design: Exposed “T”.
   b. Cold-rolled steel, minimum thickness of 0.020" electrozinc coated and factor painted low sheen satin.

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c. Exposed flange: 15/16" width.

3. Edge molding: Minimum 0.020" steel, angle shaped, with minimum flange width of 15/16".

4. Rough Suspension:

a. Hanger wire: Minimum 12 gauge, galvanized soft annealed, mild steel wire or hanger rod: 3/16" diameter.

b. Threaded rod for fixture support or hanger strap: 3/16"thick, 1" wide, zinc coated, flat steel strap for fixture support.

B. Acoustical Units

1. Base Bid: Cirrus, Tegular, Fine Texture by Armstrong, or approved equal.

2. Add Alternate #1: In lieu of the base bid ceiling tiles, provide and install Optima by Armstrong or approved equal with NRC of 0.85 or better.

3. Class: A

4. Performance:

a. Sound transmission coefficient: ASTM E90.

b. Noise reduction coefficient: ASTM C423.

5. Light reflectance: ASTM C523.

6. Nominal Size: 2'-0" x 2'-0" x ¾"
2'-0" x 4'-0" x ¾"

7. Finish: Factory applied.

8. Edge: Tegular.

PART 3 – EXECUTION

3.01 CONDITION OF SURFACES

A. Examine surfaces scheduled to receive suspended or directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of work.

B. Mark access provisions as to size and location before beginning installation. Delete if access provisions are not included as a part of this work.

C. Areas to which acoustical units will be cemented must be free of oils, form residue, or materials that will affect bond capabilities of adhesive.

3.02 INSTALLATION

A. Suspension Systems: ASTM C636.

B. Rough Suspension:

1. Hangers:

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a. Hanger: Wires as recommended by manufacturer.

b. Space Hanger: 4' (1.2 m) on center, each direction.

c. Install additional hangers at ends of each suspension member and at light fixtures 6" (150 mm) from vertical surfaces.

d. Do not splay wires more than 5" (127 mm) in a 4' (1.2 m) vertical drop.

e. Wrap wire a minimum of 3 times horizontally, turning ends upward.

2. Saddle tie carrying channels to main structure for indirect hung suspension system or install carrying channels with leveling clips to main structure for indirect hung suspension system.

3. Main and Cross Runners:

a. Space main runners at (Specify 1' to 5') at center, at right angle to carrying channel. Selection depends on size of acoustical units.

b. Level and square to adjacent walls, and wire clip to channels at all intersections.

c. Space cross runners at 2’-0” on center.

4. Wall Molding:

a. Install wall molding at intersection of suspended ceiling and vertical surfaces.

b. Miter corners where wall moldings intersect or install corner caps.

c. Attach to vertical surface with mechanical fasteners.

d. Install spring spacers at wall molding to hold acoustical unit snug on flange of wall molding.

5. Install splines in unsupported joints of acoustical tile, providing hairline joints in a smooth even plane.

C. Acoustical Units:

1. Install in level plane in straight line courses.

2. Place materials to bear all around on suspension members.

3. Minimum width of border tiles: One-half unit dimension.

4. Install acoustical units surrounding recessed troffer lights with hold down clips to prevent movement or displacement of units.

3.03 CLEANING

A. Clean soiled or discolored unit surfaces after installation.

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B. Touch up scratches, abrasions, voids, and other defects in painted surfaces. Remove and replace damaged or improperly installed units.

END OF SECTION

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DIVISION 09 FINISHES

SECTION 09 65 19 RESILIENT FLOORS

Filed Sub-Bid Required (Resilient Floors)

PART 1 – GENERAL

1.00 FILED SUB-BIDS

A. Resilient Flooring is stipulated as a Filed Sub-Bid under Part B, Item 2, of the FORM FOR GENERAL BID.

B. All sub-bids shall be submitted on the FORM FOR SUB-BID furnished by the Awarding Authority as required by Section 44G of Chapter 149 of the General Laws, as amended.

C. Sub-bids must be filed with the Awarding Authority in a sealed envelope, before the time stipulated in the ADVERTISEMENT, on the date stipulated in the ADVERTISEMENT.

D. Specific information relating to sub-bidders is set forth in the CONTRACT DOCUMENTS under the heading, "NOTICE TO ALL BIDDERS", and the attention of the sub-bidders is directed thereto.

E. The work to be done under this Section 09 65 19 is described herein, and on Drawings L1-01, D1-01 – D1-02, D2-01 – D2-02, A1-01 – A1-03, A2-01 – A2-02, A6-01 – A6-05, A9-01 – A9-03, FP0 – FP2, MD-1 – MD-3, M-1 – M-7, VS-1 – VS-2, E0.01, ED1.01 – ED1.02, E1.01 – E1.02, E2.01 – 03.

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

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1.02 WORK TO BE PERFORMED

A. Provide all the Resilient Floors work required to complete the work of the contract including all the Resilient Floors work shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all reinforcing, pinning, and finishes. Coordinate the Resilient Floors work with all the other trades for the project. Provide all demolition and disposal work to complete the Resilient Floors work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All work of the contract is related. It is the General Contractor's responsibility to review all the work of each section, each sub-contractor, and each file sub-bidder for the entire project so that all the work can be properly and completely performed.

B. Resilient Floor work includes, but is not limited to:

1. Install Resilient Flooring at locations indicated on the plans. Prepare floors per flooring manufacturer's recommendations.

2. **Add Alternate #1**: In lieu of specified 'Base Bid' 3mm adhered LVT, provide and install 5mm floating LVT.

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.

B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004, with Editorial Revision (2014).

C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

D. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

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C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Protect roll materials from damage by storing on end.

E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Base Bid Luxury Vinyl Tile: Glue-Down Resilient Tile Similar to Mohawk Group 'Select Step - Stone', or approved equal.

1. Thickness: 3 mm

2. Wear Layer: 20 mil. Enhanced Urethane

B. **Add Alternate #1** Luxury Vinyl Tile: Loose Lay Enhanced Resilient Tile Similar to Mohawk Group 'Hot & Heavy Collection - Secoya', or approved equal.

1. Thickness: 5 mm

2. Wear Layer: 20 mil. Enhanced Urethane

C. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.

1. Manufacturers:

a. Armstrong World Industries, Inc: www.armstrong.com.

b. Johnsonite, a Tarkett Company: www.johnsonite.com.

c. Mannington Mills, Inc: www.mannington.com.

2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.

3. Size: 12 by 12 inch.

4. Thickness: 0.125 inch.

2.02 STAIR COVERING

A. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness.

1. Manufacturers:

a. Burke Flooring: www.burkeflooring.com/#sle.

b. Johnsonite, a Tarkett Company: www.johnsonite.com.

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c. Roppe Corp: www.roppe.com.

2. Nosing: Square.

3. Color: To be selected by Architect from manufacturer's full range.

B. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.

1. Thickness: 0.080 inch.

C. Stair Nosings: 1-1/2 inch horizontal return, 1-1/8 inch vertical return, full width of stair tread in one piece.

1. Material: Rubber.

2. Texture: Smooth.

3. Color: To be selected by Architect from manufacturer's full range.

2.03 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.

1. Height: 4 inch.

2. Thickness: 0.125 inch.

3. Finish: Satin.

4. Color: To be selected by Architect from manufacturer's full range.

5. Accessories: Premolded external corners and internal corners.

2.04 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Subfloor repairs: Use a good-quality Portland-based patching compound modified with latex that has a minimal resistance to compression of 3,500 lbs/sq. in. (246 kg/cm2) to fill, smooth or level subfloor imperfections.

C. Self-levelling underlayment: Use a Portland-based self-levelling underlayment modified with a polymer that has a minimal resistance to compression of 3,500 lbs/sq. in. (246 kg/cm2).

D. Primers, Adhesives, and Seam Sealer: Waterproof; use only types recommended by flooring manufacturer.

E. Moldings, Transition and Edge Strips: Same material as flooring.

F. Filler for Coved Base: Plastic.

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PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. All subfloors should be smooth, flat and dust free with the tolerance not exceeding more than 3/16" in a 10' span. All subfloor and underlayment patching must be performed with a non-shrinking, water-resistant Portland-based patching compound.

C. Concrete subfloors must be dry, smooth and free from dust, solvent, paint, wax, grease, oil, asphalt sealing compounds and other extraneous materials. The surface must be hard and dense, and free from powder or flaking. The floor should have a moisture reading of less than 95%RH per ASTM F 2170.

D. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

E. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.

1. Test in accordance with ASTM F710.

2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

F. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

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F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

3.05 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

3.06 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.07 INSTALLATION - STAIR COVERINGS

A. Adhere over entire surface. Fit accurately and securely.

3.08 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

END OF SECTION

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DIVISION 09 FINISHES

SECTION 09 84 30 SOUND-ABSORBING WALL PANELS

Filed Sub-Bid Required (Acoustical Tile)

PART 1 GENERAL

1.00 FILED SUB-BIDS

A. Acoustical Tile is stipulated as a Filed Sub-Bid under Part B, Item 2, of the FORM FOR GENERAL BID.

B. All sub-bids shall be submitted on the FORM FOR SUB-BID furnished by the Awarding Authority as required by Section 44G of Chapter 149 of the General Laws, as amended.

C. Sub-bids must be filed with the Awarding Authority in a sealed envelope, before the time stipulated in the ADVERTISEMENT, on the date stipulated in the ADVERTISEMENT.

D. Specific information relating to sub-bidders is set forth in the CONTRACT DOCUMENTS under the heading, "NOTICE TO ALL BIDDERS", and the attention of the sub-bidders is directed thereto.

E. The work to be done under this Section 09 84 30 is described herein, in Section 09 51 23, and on Drawings L1-01, D1-01 – D1-02, D2-01 – D2-02, A1-01 – A1-03, A2-01 – A2-02, A6-01 – A6-05, A9-01 – A9-03, FP0 – FP2, MD-1 – MD-3, M-1 – M-7, VS-1 – VS-2, E0.01, ED1.01 – ED1.02, E1.01 – E1.02, E2.01 – 03.

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the work shall be new and of the best grade of their respective kinds.

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1.02 WORK TO BE PERFORMED

A. Provide all the Sound Absorbing Wall Panels work required to complete the work of the contract including all the Sound Absorbing Wall Panels work shown on the plans, listed in the specification, and needed to install a complete assembly in every way, with all reinforcing, pinning, and finishes. Coordinate the Sound Absorbing Wall Panels work with all the other trades for the project. Provide all demolition and disposal work to complete the Sound Absorbing Wall Panels work. Patch to match all adjacent surfaces that are disturbed, left exposed, or unfinished. All work of the contract is related. It is the General Contractor's responsibility to review all the work of each section, each sub-contractor, and each file sub-bidder for the entire project so that all the work can be properly and completely performed.

B. Sound Absorbing Wall Panels work includes, but is not limited to:

1. **Add Alternate #2** Sound-absorbing panels and mounting accessories. Install sound-absorbing glass fiber acoustic panels, total of 1,000 SF at small individual locations throughout the full-height of the existing interior brick and gypsum wallboard walls. Refer to Interior Elevations for general size and arrangement of panels.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.

D. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.

E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.

1.04 QUALITY ASSURANCE

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

B. Store units flat, in dry, well-ventilated space; do not stand on end.

C. Protect edges from damage.

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1.06 MOCK-UP

A. See Section 01 40 00 - Quality Requirements, for additional mock-up requirements.

B. Construct mock-up of acoustical units at location as indicated by Architect.

1. Minimum mock-up dimensions; 96 by 96 inches.

2. Approved mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 FABRIC-COVERED SOUND-ABSORBING UNITS

A. Manufacturers:

1. MBI Products Company, Inc..

2. Sound Concepts

3. Decoustics

4. Or Approved Equal

B. Sound Absorbing Units: Prefinished, factory assembled fabric-covered panels.

1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

C. Fabric-Covered Acoustical Panels for Walls and Ceilings:

1. Panel Core: Manufacturer's standard rigid or semi-rigid fiberglass core.

2. Noise Reduction Coefficient (NRC) of 0.80 or better.

3. Panel Thickness: As required to meet required acoustical performance.

4. Edges: Perimeter edges reinforced by a formulated resin hardener.

5. Corners: Square.

6. Color: As selected by Architect from manufacturer's full range.

7. Mounting Method: Back-mounted with mechanical fasteners.

2.02 FABRICATION

A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.

2.03 ACCESSORIES

A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:

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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

C. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:

1. Plumb and level.
2. Flatness.
3. Width of joints.

3.03 CLEANING

A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

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DIVISION 23 HVAC

SECTION 23 00 00 HVAC

Filed Sub-Bid Required (HVAC)

PART 1 GENERAL

1.00 FILED SUB-BIDS

A. Heating, Ventilating & Air-Conditioning (HVAC) is stipulated as a Filed Sub-Bid under Part B, Item 2, of the FORM FOR GENERAL BID.

B. All sub-bids shall be submitted on the FORM FOR SUB-BID furnished by the Awarding Authority as required by Section 44G of Chapter 149 of the General Laws, as amended.

C. Sub-bids must be filed with the Awarding Authority in a sealed envelope, before the time stipulated in the ADVERTISEMENT, on the date stipulated in the ADVERTISEMENT.

D. Specific information relating to sub-bidders is set forth in the CONTRACT DOCUMENTS under the heading, "NOTICE TO ALL BIDDERS", and the attention of the sub-bidders is directed thereto.

E. Sub Sub-Bid Requirements:

CLASS OF WORK	PARAGRAPH NUMBERS
Insulation	2.05, 3.04
Sheetmetal & Accessories	2.09, 2.10, 2.11, 2.12, 3.08, 3.09, 3.10, 3.11
Automatic Temperature Control	2.17, 3.16
Air & Water Balancing	3.17

If Sub-Bidder intends to perform with persons of his own staff the classes of work listed above, he must nevertheless list his own name therefore, under Paragraph E, of the FORM FOR SUB-BID.

The Work of this Section is shown on the following Drawings: To be provided.

The Trade Contractor shall also examine all other Drawings and all other Sections of the Specifications for requirements therein affecting the Work of this Section, not just those pertaining to this Sub-trade.

The work to be done under this Section 23 00 00 and Section 23 05 48 is described herein, and on Drawings L1-01, D1-01 – D1-02, D2-01 – D2-02, A1-01 – A1-03, A2-01 – A2-02, A6-01 – A6-05, A9-01 – A9-03, FP0 – FP2, MD-1 – MD-3, M-1 – M-7, VS-1 – VS-2, E0.01, ED1.01 – ED1.02, E1.01 – E1.02, E2.01 – 03.

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1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 00 00 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect Work of this Section whether or not such Work is specifically mentioned in this Section.

C. Coordinate Work with that of all other trades affecting or affected by Work of this Section. Cooperate with such trades to assure the steady progress of all Work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the Work shall be new and of the best grade of their respective kinds.

1.02 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 01 Section.

1.03 WORK TO BE PERFORMED

A. General:

1. The work described herein shall be interpreted as work to be done by the HVAC Subcontractor. Work to be performed by other trades will always be specifically referenced to that trade.

2. Furnish all staging, rigging, temporary support, labor, materials, and perform all operations in connection with the installation of the HVAC work.

3. The building is to be commissioned and this contractor shall provide all labor required to fully test and demonstrate that all systems operate as designed.

B. Without limiting the generality thereof, the work to be performed under this Section includes:

1. Heating Hot Water Piping System with Insulation, Hangers, Valves, etc.

2. Rooftop Air Handling Unit

3. Ductwork With Insulation, Hanger, Damper, etc.

4. Fintube Radiation

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5. VAV Terminal Boxes
6. Direct digital automatic temperature controls.
7. Testing, Adjusting & Balancing of all Ducted and Piped Systems and Equipment
8. Chemical Treatment Systems
9. Equipment Nameplates
10. Factory Tests
11. Seismic Restraints & Vibration Isolation (refer to Section 23 05 48)
12. Diffusers, Registers and Grilles
13. Sound Attenuators
14. Roof Curbs (Refer to Section 23 05 48)
15. Electric Terminal Equipment

1.04 DEFINITIONS

A. Most terms used within the documents are industry standard. Certain words or phrases shall be understood to have specific meanings as follows:

B. Provide: Furnish and install completely connected up and in operable condition, ready for the intended use.

C. Furnish: Purchase and deliver to a specific location within the building or site, ready for unloading, unpacking, assembly, installation, and similar operations.

D. Install: With respect to equipment furnished by others, install means to receive, unpack, move into position, mount and connect, including removal of packaging materials.

E. Conduit: Raceways of the metallic type which are not flexible. Specific types as specified.

F. Connect: To wire up, including all branch circuitry, control and disconnection devices so item is complete and ready for operation.

G. Subject to Mechanical Damage: Equipment and raceways installed exposed and less than eight feet above finished floor in mechanical rooms or other areas where heavy equipment may be in use or moved.

1.05 RELATED WORK

A. Cutting beyond the requirements as stated herein, and patching of all openings regardless of size, is specified in the respective Sections of the trade responsible for furnishing and installing similar new materials.

B. For temporary controls refer to Section 01 50 00 – TEMPORARY FACILITIES AND CONTROLS.

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C. For flashing of vents through roof and setting of roof curbs and flashing of such, refer to Section 07 62 00 – SHEET METAL FLASHING AND TRIM and Section 07 00 02 Roofing and Flashing.

D. For excavation and backfill of below grade mechanical and related systems refer to Division 31.

E. For open web steel joists refer to Section 05 21 00 – STEEL JOISTS.

F. For firestopping referenced in this Section refer to Division 07 for products and installation requirements.

G. For finished painting of mechanical systems not called for in this Section refer to Section 09 91 00 – PAINTING.

H. For interior concrete work relating to this Section refer to Section 03 30 00 – CAST-IN-PLACE CONCRETE.

I. For exterior concrete work relating to this Section refer to Section 03 30 00 - CAST-IN-PLACE CONCRETE.

J. Section 01 81 00 – COMMISSIONING.

K. Furnish access panels and doors for installation in walls, ceiling and floors at locations to permit access for adjustment, removal, replacement and servicing of all concealed equipment, valves, volume dampers, materials, etc. installed under this Section of the specifications.

L. Access panels will be installed under this Section of the related trades of the finished surfaces in which they are located.

M. Access panels shall be located in closets, storage rooms and/or other non-public areas if possible, positioned so that the equipment can be easily reached, and the size shall be sufficient for this purpose (min. 16” x 16”). When access panels are required in corridors, lobby or other habitable areas, they will be located as directed by the Owner’s Representative.

N. Access panels shall be per Division 08 spec for products and installation requirements. Required fire resistance of walls and ceilings shall be maintained.

1.06 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

A. Furnish pipe sleeves for placement into formwork by the Generator Contractor, Refer to Section 03 30 00.

1.07 PRODUCTS INSTALLED, BUT NOT FURNISHED UNDER THIS SECTION

A. Install duct-mounted smoke detectors which will be furnished by the Electrical subcontractor. The HVAC Subcontractor shall wire the appropriate fan to shut down upon detection of smoke. The Electrical Subcontractor shall power wire and wire the smoke detector to the fire alarm panel.

1.08 CODES, ORDINANCES, AND PERMITS

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A. Perform all work in accordance with the requirements of the Town of Barnstable Building Department, State of Massachusetts Building Code, and applicable State and Federal Laws. Give all requisite notices, file all requisite plans, and obtain all permits required to perform HVAC Work. Pay all fees and include in the Bid. All HVAC equipment shall be installed to meet all State, Local and Federal sound ordinances.

B. Refer to GENERAL CONDITIONS for local connection and permit fees and information regarding Utility Company back charges.

C. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.

D. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the Owner. If work is covered before examination and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.09 QUALITY ASSURANCE

A. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for pipe, valve, and equipment identification.

2. UL and NEMA Compliance: Provide ancillary electrical components, which have been listed and labeled UL, and comply with NEMA Standards.

3. FM Compliance: Provide control devices and control sequences in accordance with requirements of Factory Mutual System (FM).

4. IRI Compliance: Provided control devices and control sequences in accordance with requirements of Industrial Risk Insurance (IRI).

5. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards.

6. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models.

7. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".

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8. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

9. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA standards.

10. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

B. MSS Standard Practices: Comply with the following standards for valves:

1. MSS SP-45: Bypass and Drain Connection Standard

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

5. MSS SP-72: Ball Valves with Flanged or Butt-Welding Ends for General Service

6. MSS SP-78: Cast Iron Plug Valves, Flanged and Threaded Ends

7. MSS SP-80: Bronze Gate, Glove Angle and Check Valves

8. MSS SP-84: Steel Valves - Socket Welding and Threaded Ends

9. MSS SP-85: Cast Iron Globe and Angle Valves, Flanged with Threaded Ends

10. MSS SP-92: MSS Valve User Guide

C. Automatic Temperature Control Contractor Qualifications: Firms specializing in installation of Automatic Temperature control system for not less than 5 years.

1. Codes and Standards:

a. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.

b. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.

c. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.10 DISCREPANCIES IN DOCUMENTS

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A. Where Drawings or Specifications conflict or are unclear, advise Architect in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted.

B. Where Drawings or Specifications do not coincide with manufacturer's recommendations, or with applicable codes and standards, alert Architect in writing before installation.

C. Of the required material, installation, or work can be interpreted differently from drawing to drawing, for between drawings and specs, this contractor shall provide that material, installation, or work which is of the more stringent.

D. It is the intent of these contract documents to have the contractor provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a system. In cases such as this, where the contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner.

1.11 CONTRACT DRAWINGS

A. All work shown on the Drawings is intended to be approximately correct to scale, but shall be taken in a sense as diagrammatic. Sizes of ductwork and pipes and general method of running them are shown, but it is not intended to show every offset and fitting which is only possible after final coordination with all sub-contractors and submission of coordination drawings. No additional compensation will be allowed for offsets and fittings not specifically shown of the contract drawings. To carry out the true intent and purpose of the plans, furnish all necessary parts to make complete working systems ready for use.

B. The HVAC Drawings and Specifications are intended to supplement each other so that any details shown on the Drawings and not mentioned in the Specifications, or vice-versa, shall be executed the same as if mentioned in the Specifications and shown on the Drawings.

C. Refer to the Architectural, Structural, Plumbing, Mechanical and Electrical Drawings which indicate the construction in which this work shall be installed. Locations shown on the plans shall be checked against the general and detailed Drawings of the construction proper. All measurements must be taken at the building.

1.12 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun, the respective Subcontractor shall prepare and submit to the Architect Coordination Drawings showing the

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size, elevation and location of his equipment, fixtures, ductwork, conduit, and piping lines relevant to the complete system. He shall ensure that these drawings are compatible and correctly annotated and cross-referenced at their interfaces.

B. Coordination drawings are for the Contractor's and the Architect's use during construction and shall not be construed as replacing any shop or record drawings required elsewhere in the Contract Drawings.

C. All coordination drawings shall be prepared in a large enough scale to accurately identify work of each trade and in addition to each sub-contractors systems, shall also show architectural floor plan, reflected ceiling plan, and structural framing with grid identification.

D. The coordination drawing shall be started by the sheet metal sub-contractor and after applying all ductwork, the drawing shall be submitted for ductwork approval by the engineer. After approval, the drawing shall be circulated to the remaining sub-contractors for application of their work.

E. During coordination drawing preparation the sub-contractors shall meet periodically to discuss overall coordination of all sub systems, and shall adjust their systems accordingly. When all drawings are complete the general contractor shall submit to the architect and engineers for review.

F. Areas of conflict that cannot be resolved between the sub-contractor must be flagged on the drawings with adequate information to assist the architect and engineer in resolving noted issues.

G. Refer to DIVISION 01 – GENERAL REQUIREMENTS of these Contract Documents for additional procedures relative to the preparation of Coordination Drawings.

H. Any additional time required to draw and/or re-draw coordination drawings due to conflicts shall be completed at no additional cost to the Owner and/or Project.

1.13 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for service and removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

1.14 ROUGH IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. This Sub-contractor shall disconnect, lower to floor, and stack near-by all noted mechanical systems being removed. The General Contractor shall remove from the building and dispose of in a legal manner.

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1.15 NOTIFICATION OF RELATED TRADES

A. Notify all other trades responsible for installing chases, inserts, sleeves, anchors, louvers, etc. when ready for such installation and for final checking immediately before concrete is placed. Cooperate with such trades to obtain proper installation.

B. Leave openings in walls for pipes, ducts, etc. for mechanical and electrical work as shown on Drawings or required by layout of mechanical or electrical systems.

1.16 MECHANICAL INSTALLATIONS

A. Coordinate mechanical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

G. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

H. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

I. Coordinate connection of mechanical system with overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

1.17 CUTTING AND PATCHING

A. Drilling, coring, and cutting of new and existing structures (through walls, floors, ceiling, etc.) where the largest dimension does not exceed 12" shall be by this Contractor.

B. Throughout the performance of the cutting and coring work, ensure that the structural integrity of the existing walls, floors, overhead structure, and other structural components, which are to remain, is maintained until permanent work is installed. Prior to any coring or cutting verify all locations of same with the General Contractor. All cutting and coring is to be performed in accordance with

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approved coordination drawings. All cutting or coring of structural must receive approval of the Architect prior to proceeding.

C. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

D. Patching of surfaces shall be by the trade responsible for the surface penetrated.

1.18 SUBMITTALS

A. Refer to SECTION 01 33 00 – SUBMITTAL REQUIREMENTS for submittal definitions, requirements, and procedures. The following paragraphs supplement the requirements of Section 01 33 00.

B. Submittal of Shop Drawings, product data, and samples will be accepted only when submitted by the General Contractor. Data submitted by Sub-contractors and material suppliers directly to the Architect/Engineer will not be processed. Submittals will be electronic unless physical sample are required.

C. Provide submittals for the following equipment:

1. Valves
2. Meters and Gauges
3. Hangers and Attachments
4. Mechanical Identification
5. Mechanical Insulation
6. Hydronic Piping
7. Terminal Heating Units
8. Rooftop Units
9. Metal Ductwork
10. Ductwork Accessories
11. Sound Attenuators
12. Air Outlets and Inlets
13. Automatic Temperature Controls
14. Air and Water Testing and Balancing
15. Acoustic Liner
16. Variable Air Volume Boxes

D. If a Shop Drawing is not accepted after two submissions, a third submission from the same manufacturer will not be considered.

E. Check Shop Drawings and other submittals to assure compliance with contract documents before submittal to A/E.

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F. Review of Shop Drawings is final and no further changes shall be considered without written application. Shop Drawings review does not apply to quantities, nor relieve this Contractor of his responsibility for furnishing materials or performing his work in full compliance with these Contract Drawings and Specifications. Review of these shop drawings shall not be considered a guarantee of the measurements of this building or the conditions encountered.

1.19 SUBSTITUTIONS

A. Refer to, SECTION 01 60 00 – PRODUCT REQUIREMENTS for requirements in requesting substitutions. The following paragraphs supplement the requirements of Section 01 60 00.

B. If materials or equipment are substituted for specified items that alter the systems shown or its physical characteristics, or which have different operating characteristics, clearly note the alterations or difference and call it to the attention of the a/e. Under no circumstances shall substitutions be made unless material or equipment has been successfully operated for at least three consecutive years.

C. Any modifications to the design, as a result of approving a substitution, shall be the responsibility of this contractor. Any additional cost to this contractor or any other contractor, directly or indirectly, as a result of such substitutions, shall be the responsibility of this contractor.

1.20 PRODUCT LISTING

A. Prepare listing of major mechanical equipment and materials for the project.

B. Provide all necessary information.

C. Submit to the A/E through the General Contractor, within twenty (20) days of signing contract, this listing indicating all equipment and manufacturers, as a part of the submittal requirement. If the product list is not submitted, it will be the responsibility of the sub-contractor to submit one (1) of the three (3) named equal manufacturers.

D. When two or more items of same material or equipment are required they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in work, except as otherwise indicated.

E. Provide products, which are compatible within systems and other connected items.

1.21 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, mode, number, serial number, capacity, operating, and power characteristics labels of tested

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compliances, and similar essential data. Locate nameplates in an accessible location.

1.22 DELIVERY, STORAGE AND HANDLING

A. Refer to Section General Conditions for delivery, storage, and handling of equipment. The following paragraphs supplement the requirements of Section General Conditions.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Store equipment and materials off-site. Protect stored equipment and materials from damage.

D. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.23 RECORD DOCUMENTS

A. Refer to Section 01 77 00 – CONTRACT CLOSEOUT for requirements for record documents. The following paragraphs supplement the above.

B. Provide electronic Auto Cad 2014 or newer drawings. Modify electronic Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column line; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located. Also provide ATC Drawings showing As-Built conditions indicating point to point wiring from field devices to the control panels as well as floor plans indicating actual controller locations and communication wiring routes, modified sequences, field changes and any additional HVAC items added through change orders, ASI & RFI.

1.24 OPERATION AND MAINTENANCE DATA

A. Refer to Section 01 77 00 – CONTRACT CLOSEOUT for procedures and requirements for preparation and submittal of maintenance manuals. The following paragraphs supplement the requirements of Section 01 77 00.

B. In addition to the information required by Section 01 77 00 for maintenance data, include the following information:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

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2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and user summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and trouble-shooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Provide DVD recording of operation and maintenance training sessions and include as part of O & M Manual submittal. Provide indexed table of contents for DVD recording.

6. ATC Drawings/Submittal of As-Built conditions including building CAT6 wiring, field devices, controllers, etc. for a complete as built condition.

1.25 WARRANTIES

A. The contractor shall provide a one (1) year minimum warrantee on all product (unless otherwise stated in the product specification for a specific product) and labor for work under this section.

B. Refer to Section General Conditions and Section 01 77 00 CONTRACT CLOSEOUT for additional procedures and submittal requirements for warranties.

1.26 WELDING QUALIFICATIONS

A. Piping shall be welded in accordance with qualifications procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operations qualified by another employer may be accepted as permitted by ASME B31.1. The Owner's Representative shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Division 01.

B. When open-flame or spark producing tools such as welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain constant fire watch/fire detail (by the Barnstable Fire Department) where work is being performed and until it is completed. This Contractor shall be responsible for obtaining required permit and paying all permit fees and Firewatch detail expenses.

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1.27 COMMISSIONING

A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 81 00 – COMMISSIONING.

B. Complete installation and startup checks and functional tests according to Section 01 81 00 – COMMISSIONING and manufacturers written instructions.

C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the start up procedure.

D. Verify that equipment is installed and commissioned as per requirements of Section 01 81 00 – COMMISSIONING and manufacturer's written instructions/requirements.

1.28 TRADE RESPONSIBILITY COORDINATION MATRIX

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
Smoke Detectors (Area type)	26 00 00	26 00 00	26 00 00	23 00 00 (ATC)	26 00 00	
Smoke Detectors (Duct mounted)	26 00 00	23 00 00	26 00 00	23 00 00 (ATC)	26 00 00	
Smoke & Fire/Smoke Dampers	23 00 00	23 00 00	N/A	N/A	N/A	
Smoke & Fire/Smoke Damper Actuators	23 00 00	23 00 00	26 00 00 & 23 00 00 (ATC)	23 00 00 (ATC)	26 00 00	2
Fire Dampers	23 00 00	23 00 00	N/A	N/A	N/A	
VAV Boxes	23 00 00	23 00 00	26 00 00	23 00 00 (ATC)	N/A	2
VAV Box Damper Actuator	23 00 00 (ATC)	Box Mfr	23 00 00 (ATC)	23 00 00 (ATC)	N/A	2

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Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring	Notes
VAV Box DDC Controller	23 00 00 (ATC)	Box Mfr	23 00 00 (ATC)	23 00 00 (ATC)	N/A	2
Hydronic Control Valves	23 00 00 (ATC)	23 00 00	N/A	23 00 00 (ATC)	N/A	1
Hydronic Control Valve Actuator	23 00 00 (ATC)	23 00 00 (ATC)	23 00 00 (ATC)	23 00 00 (ATC)	N/A	1
Sheet Metal Damper	23 00 00	23 00 00	N/A	N/A	N/A	1
Sheet Metal Damper Actuators	23 00 00 (ATC)	23 00 00 (ATC)	23 00 00 (ATC)	23 00 00 (ATC)	N/A	1
Airflow Measuring Stations	23 00 00 (ATC)	23 00 00 (ATC)	N/A	23 00 00 (ATC)	N/A	
DDC Panels	23 00 00 (ATC)	23 00 00 (ATC)	26 00 00 & 23 00 00 (ATC)	23 00 00 (ATC)	N/A	3
VFDs at AHU, EFs, RTU	23 00 00 (ATC)	23 00 00 (ATC)	26 00 00	23 00 00 (ATC)	N/A	

Notes:

1. Division 23 00 00 and Division 23 00 00 (ATC) Contractors shall fully coordinate all airflow damper and hydronic valves sizes and quantities.
2. Smoke Damper and VAV Box power wiring shall be provided by Division 26 00 00 to junction box locations shown on electrical drawings; Division 23 00 00 (ATC) Contractor shall provide final power wiring from junction box to end device location.
3. Division 26 00 00 shall provide power at main DDC Panel. Division 23 00 00 (ATC) shall provide power to all other DDC Panels.

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1.29 ENERGY REBATE PROGRAM

A. This project has been designed to incorporate equipment approved for energy rebate such as boilers, high efficiency motors, rooftop units and heat recovery units. HVAC subcontractor shall review Utility Company requirements prior to submitting shop drawing to ascertain that submittal meets program guidelines. All submitted equipment shall meet utility company rebate program efficiency requirements. HVAC subcontractor shall furnish equipment submittals, related equipment/system pricing data and all required rebate application information, and forms to utility company.

1.30 HAZARDOUS MATERIALS

A. The HVAC Sub-contractor shall be responsible for removing and legally disposing of any and all hazardous waste associated with HVAC systems, including but not limited to:

1. All chemical treatment used in flushing out HVAC piping systems.
2. Un-used excess material such as adhesives used in ductwork and piping installations.
3. Refrigerant in all AC systems.
4. Propylene Glycol (where applicable)
5. Items specifically noted on drawings.

1.31 PHASING

A. The HVAC subcontractor shall construct the subject project in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

B. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the Architectural drawings.

1.32 DEMOLITION

A. Where existing heating equipment (i.e. coils, fans, radiation, unit ventilators etc.) are called to be removed, it shall include all associated piping, valves, wiring, controls, hangers, associated ductwork, and all associated appurtenances.

B. Where existing piping (i.e. hot water, condensate drain, refrigerant piping etc.) and ductwork are called to be removed, it shall include all associated hangers, insulation, valves, controls, dampers and all associated appurtenances.

C. This Sub-contractor shall disconnect, lower to floor, and stack near-by all noted mechanical systems being removed. The General Contractor shall remove from the building and dispose of in a legal manner.

D. Refer to section 02 41 19 - DEMOLITION for additional information and requirements.

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1.33 HOISTING EQUIPMENT AND MACHINERY

A. Unless otherwise specified, all hoisting and rigging equipment and machinery required for the proper and expeditious prosecution and progress of the Work of this Section shall be furnished, installed, operated and maintained in safe condition by each sub-contractor, as specified under Section 015000, TEMPORARY FACILITIES AND CONTROLS and Section 007225 – CM Supplemental Conditions.

1.34 STAGING AND SCAFFOLDING

A. Unless otherwise specified, each sub-contractor shall provide all lifts and man-lifts, and furnish, erect and maintain in safe condition, all staging and scaffolding as specified under Section 015000 Temporary Facilities and Controls and Section 007225 – CM Supplemental Conditions, as needed for proper execution of the work of this Section. Staging and scaffolding shall be of adequate design, erected and removed by experienced stage builders having all accident prevention devices required by Federal, state and local laws.

PART 2 PRODUCTS

2.00 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT (Refer to SECTION 018100 - COMMISSIONING for additional contract requirements)

A. Pursuant to Massachusetts General Laws Chapter 141, a Massachusetts Licensed electrician shall install all low voltage wiring required by this section.

B. General: The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. All motors for all mechanical equipment shall be NEMA premium efficiency matching the following and all motors associated with variable frequencies drives shall be inverted duty motor with Aegis bearing protection rings:

HP	RPM	Efficiency
1	1800	85.5 percent
1.5	1800	86.5 percent
2	1800	86.5 percent
3	1800	89.5 percent
5	1800	89.5 percent
7.5	1800	91.0 percent
10	1800	91.7 percent
15	1800	93.0 percent

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20	1800	93.0 percent
25	1800	93.6 percent
30	1800	94.1 percent
40	1800	94.1 percent
50	1800	94.5 percent

2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
4. Temperature Rating: Rated for 40 degrees C. environment with maximum 50 degrees C temperature rise for continuous duty at full load (Class F Insulation). All ratings shall be for inverter duty applications.
5. Starting Capability: Frequency of starts as indicated by automatic control system and not less than five evenly time spaced starts per hour for manually controlled motors.
6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
7. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
8. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
9. Bearings:
    a. Ball or roller bearings with inner and outer shaft seals.
    b. Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
    c. Designed to resist thrust loading where belt drivers or other drives produce lateral or axial thrust in motor.
    d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.
10. Enclosure Type:
    a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
    b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
    c. Weather protected Type I for outdoor use, Type II where not housed.

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11. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

12. Noise Rating: "Quiet".

13. Efficiency: "Premium Efficient" motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, Test Method B.

14. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

15. Provide AEGIS magnetic bearing protection ring for all inverter rated motors that are controlled by variable speed drives. The bearing protection ring shall channel harmful shaft voltages to ground to protect bearing races from pitting.

C. Starters, Electrical Devices, And Wiring: (Provided By The HVAC Subcontractor For Each Packaged Piece Of HVAC Equipment Requiring Such):

1. Motor Starter Characteristics:

   a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.

   b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

2. Manual Switches shall have:

   a. Pilot lights and extra position for multi-speed motors.

   b. Overload Protection: Melting alloy type thermal overload relays.

3. Magnetic Starters:

   a. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

   b. Trip-free thermal overload relays, each phase.

   c. Interlocks, pneumatic switches and similar devices as required for co-ordination with control requirements of Division 23 Controls Sections.

   d. Built-in 120 volts control circuit transformer, fused from line side, where service exceeds 240 volts.

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e. Externally operated manual reset.

f. Under-voltage release or protection.

4. Capacitors:

a. Individual unit cells.

b. All welded steel housing.

c. Each capacitor internally fused.

d. Non-flammable synthetic liquid impregnant.

e. Craft tissue insulation.

f. Aluminum foil electrodes.

g. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors one horsepower and larger, that have an uncorrected power factor of less than 85 percent at rated load.

5. Disconnect Switches:

a. Fusible Switches: Fused, each phase; general duty; horsepower rated; non-teasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.

b. Non-fusible Switches: For equipment two horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment larger than two horsepower, switches shall be the same as fusible type.

2.01 VALVES

A. General:

1. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.

2. Valves shall have rising stem, or rising outside screw and yoke stems; except, non-rising stem valves may be used where headroom prevents full extension of rising stems.

3. Pressure and temperature ratings shall be as required to suit system pressures and temperatures.

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4. Unless otherwise indicated, provide valves of same size as upstream pipe size. Automatic control valves shall be sized by the ATC Contractor and shall not exceed a 3 PSI drop.

5. Provide the following special operator features:

   a. Handwheels fastened to valve stem, for valves other than quarter turn, by brass nut on a square-topped stem.

   b. Lever handle on quarter-turn valves 6" and smaller, except for plug valves. Provide one wrench for every 10 plug valves, and one year's supply of recommended lubricant and sealant.

   c. Chain-wheel operators for valves 2-1/2" and larger installed 72" or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.

   d. Gear drive operators on quarter-turn valves 8" and larger.

6. Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

7. Bypass and drain connections shall comply with MSS SP-45.

8. End connections shall be as specified in the individual valves specifications.

   a. Threads: Comply with ANSI B2.1.

   b. Flanges: Comply with ANSI B16.1 for cast iron ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

9. Solder-Joint: Comply with ANSI B16.18.

   Caution: Where soldered end connection are used, use solder having a melting point below 840° F. for gate, globe, and check valves; below 421° F. for ball valves.

B. Gate Valves:

Gate Valves (Heating Hot Water) - 2" and smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze, threaded ends, solid disc, bronze alloy stem with less than 6% zinc content, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

	THREADED	
MANUFACTURER	NRS	RS
Crane:	x	431UB
Jenkins:	x	47CU
Lunkenheimer:	x	3151

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Nibco:	T-136	T-134
Stockham:	B-130	B-120
Milwaukee:	141M	1151M

1. Gate Valves (Heating Hot Water) 2-1/2" and larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B, flanged ends, and "Teflon" impregnated packing and two-piece backing gland assembly.

MANUFACTURER	OS&Y RS	NRS
Crane:	465-1/2	461
Jenkins:	651C	326C
Lunkenheimer:	1430	1428
Nibco:	F-617-0	F-619
Stockham:	G-623	G-612
Milwaukee:	F-2885-M	F-2882-M

C. Ball Valves:

1. Ball Valves (Heating Hot Water) 1" and smaller: Rated for 150 psi saturated steam pressure, 600 psi WOG pressure, 2-piece construction, bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide threaded ends for heating hot water, soldered for chilled water.

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Milwaukee:	BA-100	BA-150
Conbraco (Apollo)	70-100	70-200
Crane:	9302	9322
Jamesbury:	21-1000TT	x
Jenkins:	900A	902A
Lukenheimer:	AQ311	x
Nibco:	T-585	S-585
Watts:	B-6000	B-6001
Stockham:	S-216 BR-R-T	S-216 BR-R-S

2. Ball Valves (Heating Hot Water) 1-1/4" to 2": Rated for 150 psi saturated steam pressure, 600 psi WOG pressure; 3-piece construction, bronze body

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conforming to ASTM B 62, conventional port, chrome-plated brass ball, replaceable

"Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide threaded ends for heating hot water, soldered for chilled.

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Milwaukee:	BA-300	BA-350
Conbraco (Apollo):	82-100	82-200
Nibco:	T-595-Y	S-595-Y
Watts:	B-6800	B-6801
Stockham:	S-216 BR-R-T	S-216 BR-R-T

For grooved end connections use Victaulic Style 721.

D. Plug Valves:

1. Plug Valves - 2" and smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.

MANUFACTURER	
Rockwell:	214.
Lunkenheimer:	454.
Crane:	250.

2. Plug Valves - 2-1/2" and larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

MANUFACTURER	
Rockwell:	305.
Nordstrom:	143.
Serck-Audco:	LSW-133-GG.
Homestead:	612.

(8" and larger to be Gear Operated).

E. Globe Valves:

1. Globe Valves (Heating Hot Water) - 2" and smaller: MSS Sp-80; Class 150, body and union bonnet of ASTM B 62 cast bronze, threaded ends, brass or replaceable composition disc, bronze alloy stem with less than 6%

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zinc content, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

MANUFACTURER	
Jenkins:	106-B.
Lunkenheimer:	407.
Nibco:	T-235-Y.
Stockham:	B-22.

2. Globe Valves (Heating Hot Water) - 2-1/2" and larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing and two-piece backing gland assembly.

MANUFACTURER	STRAIGHT BODY	ANGLE BODY
Milwaukee:	F-2981-M	x
Crane:	351	353
Jenkins:	613C	x
Lunkenheimer:	1123	x
Nibco:	F-718-B	x
Stockham:	G-512	G-515

F. Butterfly Valves:

1. Butterfly Valves (Heating Hot Water) - 2-1/2" and larger: MSS SP-67; 200 psi, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with aluminum bronze disc, stainless steel, and EPDM 0-ring stem seals. Sizes 2 through 6" shall have lever operators with locks, and sizes 8 through 24" shall have gear operators with position indicator. Valves on dead end service or requiring additional body strength shall be lug-wafer type, drilled and tapped.

MANUFACTURER	WAFER	
	LEVER	GEAR
Milwaukee:	x	MW-123-E
Center Line:	x	Series A
Crane:	42	x
Keystone:	100	x
Nibco:	WD-20003	WD-20003

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Stockham:	LG-512-BS3E	LG-522-BS3E
	LUG	
	LEVER	GEAR
Milwaukee:	x	ML-123-E
Center Line:	x	Series LT
Crane:	44	x
Keystone:	129	x
Nibco:	LD-20003	LD-20005
Stockham:	LG-712-BS3E	LG-722-BS3E
Grooved Ends:	Victaulic Series 704.	

G. Check Valves:

1. Swing Check Valves (Heating Hot Water) - 2" and smaller: MSS SP-80; Class 150, cast bronze body and cap, conforming to ASTM B 62, horizontal swing, with a Teflon disc, and having threaded ends. Valve shall be capable of being repaired while the valve remains in the line.

MANUFACTURER	
Milwaukee:	510T
Crane:	x
Jenkins:	352C
Lunkenheimer:	230-70
Nibco:	T-433-Y
Stockham:	B-321

For grooved connections us Victaulic Series 712.

2. Swing Check Valves (Heating Hot Water) - 2-1/2" and larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

MANUFACTURER	CLASS 125	CLASS 175
Milwaukee:	F-2974-M	x
Crane:	373	375
Jenkins:	624C	477

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Lunkenheimer:	1790	x
Nibco:	F-918B	x
Stockham:	G-931	G-940

3. Wafer Check Valves (Heating Hot Water) - (Non-Slam): Class 250, cast iron body, replaceable lapped bronze seat, lapped and balanced twin bronze flappers and stainless steel trim. Valve shall be designed to open and close at approximately one foot differential pressure. Twin flappers shall be loaded with a stainless steel torsion spring to minimize flapper drag and assure even non-slam checking action.

MANUFACTURER	
Milwaukee:	1400-2C
Center Line:	CLC
Metraflex:	hexx
Mission:	12HMP
Stockham:	WG970

For grooved connection use Victaulic Series 710 and 711.

4. Lift Check Valves - 2" and smaller: Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal, lift type valve, bronze disc and threaded ends. Valve shall be capable of being refitted and ground while the valve remains in the line.

MANUFACTURER	HORIZONTAL
Milwaukee:	544
Hammond:	901
Jenkins:	17C
Lunkenheimer:	142

2.02 METERS AND GAUGES

A. Glass Thermometers:

1. General: Provide glass thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

2. Case: Die cast aluminum finished in baked epoxy enamel, glass front, spring secured, 9" long.

3. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.

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4. Tube and Capillary: Blue Spirit filled, magnifying lens, 1% scale range accuracy, shock mounted.
5. Scale: Satin faced, non-reflective aluminum, permanently etched markings.
6. Stem: Copper-plated steel, or brass, for separable socket, length to suit installation.
7. Range: Conform to the following:
   a. Hot Water: 30° - 240° F. with 5° F. scale.
8. Manufacturer: Subject to compliance with requirements, provide glass thermometers of one of the following:
   a. Ernst Gage Co.
   b. Marshalltown Instruments, Inc.
   c. Trerice (H.O.) Co.
   d. Weis Instruments, Inc.
   e. Or equal

B. Thermometer Wells:
1. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.
2. Manufacturer: Same as thermometers.

C. Pressure Gauges:
1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
2. Type: General use, 1% accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection.
3. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.
4. Connector: Brass with 1/4" male NPT. Provide protective siphon when used for steam service.
5. Scale: White coated aluminum, with permanently etched markings.
6. Range: Conform to the following:
   a. Water: 0 - 100 psi.
      50 - 300 psi.

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7. Manufacturer: Subject to compliance with requirements, provide pressure gauges of one of the following:
   a. Ametek/U.S. Gauge.
   b. Marsh Instrument Co., Unit of General Signal.
   c. Marshalltown Instruments, Inc.
   d. Trerice (H.O.) Co.
   e. Weiss Instruments, Inc.
   f. Or equal

D. Pressure Gauge Cocks:
1. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Construct gauge cock of brass with 1/4" female NPT on each end, and "T" handle brass plug.
2. Siphon: 1/4" straight coil constructed of brass tubing with 1/4" male NPT on each end.
3. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
4. Manufacturer: Same as for pressure gauges.

E. Annular Element Flow Meters and Fittings:
1. General: Provide as indicated, flow metering elements constructed of brass and stainless steel, equipped with readout valves to facilitate connecting of differential pressure meter to flow meter. Equip each readout valve with integral shut-off valve designed to minimize system fluid loss during monitoring process. Provide ball type brass isolation valve. Provide calibrated nameplate with flow meter detailing its flow range through range of differential head pressures. Each element shall be of the bi-directional type having four diametrically opposed sensing ports on both upstream and downstream sides in order to ensure average velocity and static pressure. Elements shall be capable of operating at a maximum temperature of 300° F. and maximum pressure of 250 psig.
2. Manufacturer: Subject to compliance with requirements, provide flow meters of one of the following:
   a. Preso Industries Corp.
   b. Meriam Instrument.
   c. Dieterich Standard Corp.
   d. Or equal

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F. Calibrated Balance Valves:

1. General: Provide as indicated, calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate to indicated degree of closure of precision machined orifice. Construct balancing valve with internal EPT 0-ring seals to prevent leakage around rotating element. Provide balance valves with preformed polyurethane insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.

2. Manufacturer: Subject to compliance with requirements, provide calibrated balance valves of one of the following:

a. Bell & Gossett ITT; Fluid Handling Div.

b. Taco, Inc.

c. Armstrong Pumps Inc.

d. Or equal

2.03 HANGERS AND ATTACHMENTS

A. Horizontal-Piping Hangers and Supports:

1. General: Except as otherwise indicated, provide factory-fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacture for each piping service. Select size of hangers and supports to exactly fit pip size for bare piping, and to insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

a. Adjustable Steel Clevises Hangers: MSS Type 1.

b. Steel Pipe Clamps: MSS Type 4.

c. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

1) Plate: Unguided type.

2) Plate: Guided type.

3) Plate: Hold-down clamp type.

d. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.

e. Pipe Stanchion Saddles: MSS Tube 37, including steel pip base support and cast-iron floor flange.

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f. Adjustable Pipe Saddle Supports: MSS Type 38, including steelpipe base support and cast-iron floor flange.

g. Single Pipe Rolls: MSS Type 41.

h. Adjustable Roller Hangers: MSS Type 43.

i. Pipe Roll Stands: MSS Type 44.

j. Pipe Rolls and Plates: MSS Type 45.

k. Adjustable Pipe Roll Stands: MSS Type 46.

2. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

a. Carpenter and Patterson, Inc.

b. Corner & Lada Co., Inc.

c. Elcen Metal Products Co.

d. Fee & Mason Mfg. Co.; Div. Figgie International

e. ITT Grinnel Corp.

f. Or equal

B. Vertical-Piping Clamps:

1. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps, complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

a. Two-Bolt Riser Clamps: MSS Type 8.

b. Four-Bolt Riser Clamps: MSS Type 42.

2. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

a. Carpenter and Patterson, Inc.

b. Corner & Lada Co., Inc.

c. Elcen Metal Products Co.

d. Fee & Mason Mfg. Co.; Div. Figgie International

e. ITT Grinnel Corp.

f. Or equal

C. Hanger-Rod Attachments:

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1. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-pipe hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
    a. Steel Turnbuckles: MSS Type 13.
    b. Swivel Turnbuckles: MSS Type 15.
    c. Malleable Iron Sockets: MSS Type 16.
2. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
    a. Carpenter and Patterson, Inc.
    b. Corner & Lada Co., Inc.
    c. Elcen Metal Products Co.
    d. Fee & Mason Mfg. Co.; Div. Figgie International
    e. ITT Grinnel Corp.
    f. Or equal

D. Building Attachments:

1. General: Except as otherwise indicate, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
    a. Concrete Inserts: MSS Type 18.
    b. Top Beam C-Clamp: MSS Type 19.
    c. Side Beam or Channel Clamps: MSS Type 20.
    d. Center Beam Clamps: MSS Type 21.
    e. Welded Beam Attachments: MSS Type 22.
    f. C-Clamps: MSS Type 23.
    g. Top Beam Clamps: MSS Type 25.
    h. Side Beam Clamps: MSS Type 27.
    i. Steel Beam Clamps W/Eye Nut: MSS Type 28.

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j. Linked Steel Clamps W/Eye Nut: MSS Type 29.

k. Malleable Beam Clamps: MSS Type 30.

l. Steel Brackets: One of the following for indicated loading:

1) Light Duty: MSS Type 31.

2) Medium Duty: MSS Type 32.

3) Heavy Duty: MSS Type 33.

m. Side Beam Brackets: MSS Type 34.

n. Plate Lugs: MSS Type 57.

o. Horizontal Travelers: MSS Type 58.

p. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

1) Carpenter and Patterson, Inc.

2) Corner & Lada Co., Inc.

3) Elcen Metal Products Co.

4) Fee & Mason Mfg. Co.; Div. Figgie International

5) ITT Grinnel Corp.

6) Or equal

E. Saddles and Shields:

1. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

2. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

4. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

a. Elcen Metal Products Co.

b. Pipe Shields, Inc.

c. Carpenter Patterson, Inc.

d. ITT Grinnel Corp.

e. Or equal

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F. Miscellaneous Materials:

1. Metal Framing: Provide products complying with NEMA STD ML 1.
2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A 36.
3. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
4. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
5. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section uter cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.04 MECHANICAL IDENTIFICATION

A. Plastic Pipe Markers:

1. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1
2. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1
3. Insulation: Furnish 1 in. thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2 in. beyond each end of plastic pipe marker.
4. Small Pipes: For external diameters less than 6 in. (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Laminated or bonded application of pipe marker to pipe (or insulation).
   d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 in. wide; full circle at both ends of pipe marker, tape lapped 1-1/2 in.

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B. Application: Provide pipe labels for the following piping system:

1. Heating Hot water supply and return.
2. Refrigerant liquid and suction.
3. Condensate drain.

C. Valve Tags:

1. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4 in. high letters and sequenced valve numbers 1/2 in. high, and with 5/32 in. hole for fastener.
   a. Provide 1-1/2 in. diameter tags, except as otherwise indicated.
   b. Provide size and shape as specified or scheduled for each piping system.
   c. Fill tag engraving with black enamel.
2. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Valve Schedule Frames:

1. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

E. Plastic Equipment Markers:

1. General: Provide manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:
   a. Green: Cooling equipment and components.
   b. Yellow: Heating equipment and components.
   c. Yellow/Green: Combination cooling and heating equipment and components.
   d. Blue: Equipment and components that do not meet any of the above criteria.
2. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
   a. Equipment label “ID” from schedules.
   b. Design capacity from schedules.
3. Size: Provide approximate 2-1/2 in. x 6 in. markers for each piece of equipment.

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4. Application: Provide equipment labels for the following equipment:
    a. Boilers
    b. Pumps
    c. Expansion Tanks
    d. Rooftop Units (RTU)
    e. Indoor Air Handling Units (AHU)
    f. Exhaust Fans
    g. Air Cooled Condensing Units
    h. Terminal Heating Units GAS/HW/ELEC equipped with fans
    i. Ductless Cooling Unit Systems (locate on inside panel)
    j. Glycol Feeder
    k. Air Seperator
    l. Variable Air Volume Boxes (VAV)
    m. Humidifier
    n. Heat Recovery Unit (located on inside panel)

F. Ductwork Labels:
1. Provide painted stencils or standard laminated plastic, color coded labels for the following systems:
    a. Supply Ductwork
    b. Return Ductwork
    c. Exhaust Ductwork
    d. Hazardous Exhaust
    e. Outside Air Ductwork

2.05 MECHANICAL INSULATION

A. Piping Insulation Materials:
1. Glass Wool Piping Insulation:
    a. Manufacturers:
        1) Knauf Insulation; Earthwool 1000° Pipe Insulation with ECOSE Technology
        2) Knauf Insulation; Earthwool Redi-Klad 1000° Pipe Insulation with ECOSE Technology

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3) Or similar as manufactured by Johns Manville, Manson, or Owens Corning

a) UL/ULC Classified per UL 723 or FHC 25/50 per ASTM E 84; EPD Certified by UL Environment; Living Building Challenge – Declare Red List Free for unjacketed Earthwool Pipe and composite Redi-Klad Pipe; meeting ASTM C 547, Type IV (1000° F.) or Type I (850° F.) ; ASTM C 585; ASTM C 411 and ASTM C 795; Verified to be formaldehyde free by UL Environment.

b. Vapor Retarder Jacket: ASJ+/SSL+ conforming to ASTM C 1136 Type I,II, III, IV, &VIII secured with self-sealing longitudinal laps and matching butt strips.

c. Redi-Klad Jacket: VentureClad 5-ply weather and abuse resistant with self-sealing lap. Zero permeability per ASTM E 96-05; puncture resistance 35.4 kg (189.3 N) per ASTM D 1000; tear strength 4.3 lb (19.4 N) per ASTM D 624; thickness 14.5 mils (0.0145”); tensile strength 68 lb/inch width [306 N (32 kg)/25 mm]

2. Flexible Unicellular Piping Insulation: ASTM C 534, Type as required.

a. Type I - tubular; Type II - sheet. For use between -40 degrees F and 200 degrees F.

3. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations.

4. Encase straight pipe insulation, where exposed in occupied areas, using Redi-Klad Pipe Insulation or cover “standard” insulation with one piece 20-mil thick PVC Jacketing. Fasten and seal as per manufacturer's recommendations.

5. Encase exterior piping insulation using Redi-Klad Pipe Insulation or cover “standard” insulation with aluminum jacket with weather-proof construction.

6. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

7. Adhesives, Sealants and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

B. Piping Insulation Application and Thickness:

1. Application: Cold Piping (40 Degrees F to Ambient):

a. Insulate the following cold HVAC piping systems:

1) Air conditioner condensate drain piping.

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2) Refrigerant liquid and suction piping.

b. Insulate piping system specified above with the following type and thickness of insulation:

1) Glass Wool: 1-1/2 in. thick for all pipe sizes.

2. Application: Hot HVAC Piping (to 200 Degrees F)

a. Insulate the following hot HVAC piping systems

1) HVAC hot water supply and return piping.

2) Hot gas refrigerant piping.

b. Insulate each piping system specified above with the following type and thickness of insulation:

1) Glass Wool: 1-1/2 in. thick for pipe sizes up to and including 1-1/4 in, 2 in. thick for all 1-1/2 in. pipe and larger.

2) Flexible Unicellular: (Refrigerant piping only) 1 in. thick.

C. Insulation on Piping Exposed to Weather: Protect outdoor insulation from weather by installing Redi-Klad Pipe Insulation or adding an outdoor protective finish aluminum jacketing installed to "standard" insulation as recommended by the manufacturer. Insulation thickness shall be increased by one size versus specified pipe insulation thickness.

D. Ductwork and Equipment Insulation Materials:

1. Glass Wool Manufacturers:

a. Knauf Insulation

b. Or similar as manufactured by CertainTeed, Johns Manville, Manson or Owens Corning

2. Rigid Glass Wool Ductwork Insulation (R-9.1): UL/ULC Classified unfaced, ASJ+, ASJ and FSK; FHC 25/50 per ASTM E 84 for PSK only; meeting ASTM C 612, Type IA and IB; rigid. Verified to be formaldehyde free by UL Environment, Living Building Challenge – Declare Red List Free.

3. Flexible Glass Wool Ductwork Insulation (R-6): UL/ULC Classified; meeting ASTM C 553 Types I, II and III; ASTM C 1136 Type II and ASTM C 1290. UL GREENGUARD Gold Certified; Verified to be formaldehyde free by UL Environment; does not contain polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE; Certified to meet all requirements of EUCEB. Flexible, limited combustible.

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4. Jackets for Ductwork Insulation: ASTM C 1136 Type II, with vapor barrier.

5. Ductwork Insulation Accessories: Provide staples, bands, wire, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

6. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Application and Thickness:

1. Application: Ventilation and AC System Ductwork:

a. Insulate the following ductwork:

1) HVAC supply ductwork between HVAC unit discharge and room terminal outlet.

2) Insulate neck and bells of supply diffusers.

3) HVAC return ductwork between room terminal inlet and HVAC unit inlet.

4) HVAC plenums and unit housing not pre-insulated at factory or lined.

b. Insulate each ductwork system specified above with the following type and thickness of insulation:

1) Rigid Glass Wool: In machine rooms, fan rooms, and mechanical spaces insulate all supply air, return air and outside air ductwork with 2 in. thick rigid (minimum R-9.1). All exposed ductwork in occupied areas shall be insulated with same thickness and material.

2) Flexible Glass Wool: 1-1/2 in. installed thickness (minimum R-6), application limited to concealed locations which shall include above ceilings, in chases, and shafts.

3) All outside air ductwork shall be 2 in. rigid (R-9.1).

2.06 HYDRONIC PIPING AND ACCESSORIES

A. Manufacturer: Subject to compliance with requirements, provide piping system products from one of the following:

1. Grooved Mechanical Joint Pipe, Fittings and Couplings:

a. Victaulic Company of America.

b. Anvil Gruvlok

c. Grinnell

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d. Or equal

2. Pump Discharge Valves (Triple-Duty Valve):
   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Amtrol, Inc.
   c. Armstrong Pumps, Inc.
   d. Taco, Inc.
   e. Victaulic (Tri-Service Assembly)
   f. Or equal
3. Safety Relief Valves:
   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Amtrol, Inc.
   c. Spirax Sarco.
   d. Watts Regulator Co.
   e. Or equal
4. Pressure Reducing Valves:
   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Amtrol, Inc.
   c. Armstrong Pumps, Inc.
   d. Taco, Inc.
   e. Or equal
5. Air Vents (Automatic):
   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Armstrong Machine Works.
   c. Hoffman Specialty ITT; Fludi Handling Div.
   d. Spirax Sarco.
   e. Or equal
6. Air Separators:
   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Amtrol, Inc.
   c. Armstrong Pumps, Inc.
   d. Taco, Inc.

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e. Or equal

7. Diaphragm-Type Compression Tanks:
   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Amtrol, Inc.
   c. Armstrong Pumps, Inc.
   d. Or equal
8. Pump Suction Diffusers:
   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Amtrol, Inc.
   c. Armstrong Pumps, Inc.
   d. Taco, Inc.
   e. Victaulic (style 731-D / W731-D)
   f. Or equal
9. Chemical Feeder:
   a. Dearborn USA.
   b. Vulcan Laboratories, Subsidiary of Clow Corp.
   c. York-Shipley, Inc.
   d. Or equal
10. Basket Strainers:
   a. Crane Co.
   b. Metraflex Co.
   c. Spirax Sarco.
   d. Victaulic Company of America. (732/W732/730/W730)
   e. Or equal

B. PIPE AND TUBING MATERIALS

1. Copper Tubing: ASTM grade B 88, Type L hard drawn temper copper tubing.
2. Copper Tubing: ASMT grade B 88, Type K, annealed copper tubing.
3. Steel Pipe: ASTM A-53 grade B, Schedule 40, seamless, black steel pipe, beveled ends.
4. CPVC Plastic Pipe: ASTM D 2846, Chlorinated Poly (Vinyl Chloride) (CPVC) pipe.

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C. FITTINGS

1. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B2.1.

2. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B2.1.

3. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

4. Grooved Mechanical Fittings: ASTM A 106, or ASTM A 53/A53M, Type F, E or S, Grade B fabricated steel, or ASTM A 234, Grade WPB forged steel fittings with grooves or shoulders designed to accept grooved end couplings.

5. Grooved Rigid Mechanical Couplings: Consist of a two- piece ductile iron housing per ASTM A536, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

   a. Rigid Couplings:

      1) Housings 12" and smaller cast with offsetting angled-pattern bolt pads to provide visual confirmation upon metal-to-metal pad contact with no torque requirement. Victaulic Style 107H and Style 07 or equal. Designs that permit spaces at bolt pads or require a torque per manufacturer's written installation instructions not permitted

      2) Housings 14" and larger cast with wedge-shaped groove profile, lead-in chamfer and flat pad design for metal-to-metal pad contact. Victaulic Style W07 or equal.

   b. Flexible Couplings:

      1) Use in locations where vibration attenuation and stress relief are required. Victaulic Style 177, 77 or W77 or equal. Three flexible couplings may be used in lieu of each flexible connector for vibration attenuation. Couplings shall be placed in close proximity to the vibrating source in accordance with published guidelines.

   c. Flange Adapters: Ductile iron housing, flat face, for use with grooved end pipe and fittings, for mating directly with ANSI Class 125, 150, and 300 flanges. Victaulic Style 741, 743 or W741 or equal.

6. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

7. CPVC Plastic Fittings: ASTM D 2846, Chlorinated Poly Vinyl Chloride (CPVC) socket-type fittings and solvent for solvent cemented joints.

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8. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced.

9. Cast Bronze Flanges: ANSI B16.24, Class 150; raised ground face, bolt holes spot faced.

10. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:

    a. Material Group: 1.1.

    b. End Connections: Butt Welding.

    c. Facings: Raised face.

11. Solder Filler Metals: ASTM B 32, 50-50, Tin-Lead, for condenser water, chilled water, and make-up water and drain piping.

12. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony, for heating hot water and low pressure steam piping.

13. Brazing Filler Metals: AWS A5.8.

14. Gasket Material: EPDM Thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

15. Flexible Connectors: Stainless steel bellows with woven flexible bronze wire reinforcing protective jacket; minimum 150 psig working pressure, maximum 250° F. operating temperature. Connectors shall have flanged, grooved or threaded end connections to match equipment connected; and shall be capable of 3/4" misalignment.

    a. Three (3) flexible couplings may be used in lieu of each flexible connector for vibration attenuation. Couplings shall be placed in close proximity to the vibrating source in accordance with published guidelines.

D. PIPE SLEEVES AND ESCUTCHEONS

1. General: Provide schedule 40 black steel or 18 gage galvanized pipe sleeve large enough to accept pipe along with specified pipe insulation at each point where pipe penetrates a wall or floor. Sleeve shall be large enough to allow for free movement of pipe however minimized to prevent leakage of smoke and fire during a fire emergency. For all piping exposed to view provide a chrome plated escutcheon that will surround insulation where applicable on pipe for a neat finished appearance. Where piping is concealed above ceilings no escutcheons are required.

E. SPECIAL DUTY VALVES

1. General: General duty valves (i.e., gate, check, ball, and butterfly valves) are specified in Division 23 Section "Valves" Special duty valves are

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specified in this Article by their generic name; refer to the drawings for specific applications of these valves.

2. Pump Discharge Valves (Triple-Duty Valve): 175 PSIG working pressure, 300° F. maximum operating temperature, cast-iron body, bronze disc and seat, stainless steel stem and spring, and "Teflon" packing. Valves shall have flanged connections and straight or angle pattern as indicated. Features shall include non-slam check valve with spring-loaded weighted disc, and calibrated adjustment feature to permit regulation of pump discharge flow and shutoff.

   a. In grooved installations, Tri-Service Assemblies may be used in lieu of Triple-Duty Valves. Straight pattern, (300-psi) pressure rating, combination shut-off, throttling, and non-slam check service in one unit. Victaulic Vic®-300 MasterSeal™ or equal, butterfly valve assembled with Series 779 Venturi Check valve or equal, with flow measurement capabilities and Victaulic or equal couplings (style to be determined by system requirements) for 2" through 12". Straight pattern, 230-psig pressure rating combination shut-off, throttling, and non-slam check service in one unit. Victaulic AGS-300 or equal butterfly valve assembled with Series W715 or equal check valve and Victaulic or equal couplings for 14" and larger.

3. Pressure Reducing Valves: Diaphragm operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down, and non-corrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory-set at operating pressure and have the capability for field adjustment.

4. Safety Relief Valves: 125 psig working pressure and 250° F. maximum operating temperature: designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron, with all wetted internal working parts made of brass and rubber. Select valve to suit actual system pressure and BTU capacity.

5. Combined Pressure/Temperature Relief Valves: Diaphragm operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down, and non-corrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory-set at operating pressure and have the capability for field adjustment. Safety relief valve designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron, with all wetted internal working parts made of brass and

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rubber; 125 psig working pressure and 250° F. maximum operating temperature. Select valve to suit actual system pressure and BTU capacity. Provide with fast fill feature for filling hydronic system.

F. HYDRONIC SPECIALTIES:

1. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure, 240° F. operating temperature; and having 1/4" discharge connection and 1/2" inlet connection.

2. Diaphragm-Type Compression Tanks: Size and number as indicated; construct of welded carbon steel for 125 psig working pressure, 375° F. maximum operating temperature. Separate air charge from flexible diaphragm securely sealed into tank. Provide taps for pressure gage and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Tank, with taps and supports, shall be constructed, tested, and labeled in accordance with ASME Pressure Vessel Code, Section VIII, Division 01.

3. Pump Suction Diffusers: Cast-iron or ductile iron body, with threaded connections for 2" and smaller, flanged or grooved connections for 2-1/2" and larger; 175 psig working pressure, 300° F. maximum operating temperature for flanged and 300 psig working pressure, 230F for grooved; and complete with the following features:

   a. Inlet vanes with length 2-1/2 times pump suction diameter or greater.

   b. Cylinder strainer with 3/16" diameter openings with total free area equal to or greater than 5 times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head.

   c. Disposable fine mesh strainer to fit over cylinder strainer.

   d. Permanent magnet, located in flow stream, removable for cleaning.

   e. Adjustable foot support, designed to carry weight of suction piping.

   f. Blowdown tapping in bottom; gage tapping in side.

4. Chemical Feeder: (Provide one (1) for each piping system). Bypass type chemical feeders of 5 gallon capacity, welded steel construction; 125 psig working pressure; complete with fill funnel and inlet, outlet, and drain valves.

5. Chemical Treatment

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a. Furnish the necessary apparatus to provide water treatment to the hot water piping systems as well as the boilers as furnished by New England Systems and Supply, Inc., GE Betz Water Technologies, or other fully capable water treatment organization approved by the Engineer.

b. A contract agreement satisfactory in form and substance shall be executed between this HVAC subcontractor and water treatment company to furnish supervisory service to assure the use of the proper chemical treatment thereof. The water treatment company shall perform the following specified services through its agent:

   1) Supervise the cleaning and flushing of all systems and the initial introduction of water treatment chemicals.

   2) Furnish all required chemicals for the cleaning and proper initial treatment of all systems hereinafter described, together with all necessary testing equipment and reagents for field analysis of the water.

   3) Submit a written report of test results of the field analyses to the Engineer when the systems are cleaned and treated with corrosion inhibitors. Submit certificate of completion for all systems indicating that all treatment systems are properly functioning and that the associated systems are properly treated.

c. The hot water piping systems shall be cleaned with sufficient chemicals to ensure the removal of all cutting oil, compound, etc. These chemicals shall not be harmful to the various materials of the systems. The treatment company representative shall supervise this operation including the flushing of the system and shall test the final rinsed system to ensure that the remnants of the cleaning solution do not impart alkalinity to the water in excess of 300 PPM.

d. Hot water systems shall be treated with sufficient amounts of the proper chemicals to conform to the Dianodic method for corrosion protection. Take various samples of water to assure proper level of chemical treatment.

e. Each boiler shall be treated with sufficient amounts of the proper chemicals to provide positive protection against corrosion, scale formation and carry over.

f. At the end of the first year of the contract agreement, the chemical treatment company shall provide to the owner and copy to Architect, a log of type, quantity and dosage of treatment and test results of treatment performed through the first year.

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g. Following the first year of service, chemical treatment company shall provide recommended maintenance and treatment schedule to owner and a copy to architect for testing and treating the water. This schedule shall be posted in the boiler room along with the testing and treatment log.

h. Upon completion of first year of service, the chemical treatment company shall instruct the owner to the owner's responsibility to test and treat water or to contract with chemical treatment company to perform testing and treatment services.

6. Y-Pattern Strainers: Cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2" and larger, threaded connections for 2" and smaller, bolted cover, perforated Type 304 stainless steel basket, bottom drain connections; 125 psig working pressure.

7. Basket Strainers: High tensile cast-iron body (ASTM A 126, Class B), flanged end connections, bolted cover, perforated Type 304 stainless steel basket, bottom drain connections; 125 psig working pressure.

8. Grooved-End Strainers:

   a. Y-Pattern: Ductile iron body ASTM A536, grooved ends for 2" and larger, coupled cover, perforated Type 304 stainless steel basket, bottom drain, 300 psig working pressure.

   b. T-Pattern: Ductile iron body ASTM A536, grooved ends for 2" and larger, coupled or T-bolt hinged cover, perforated 304 stainless steel basket, bottom drain, up to 750 psig working pressure.

9. Grooved-End Expansion for Steel Piping 2" and larger (Water Service):

   a. 2" Through 6": Packless, gasketed, slip-type expansion joint with grooved end telescoping body for installation with Victaulic Style 107 or 07 rigid couplings. Provides axial end movement to 3", designed for water services up to 230°F and working pressure to 350 psi. Victaulic Style 150 Mover®.

   b. 2" Through 24": Combination of short nipples and Victaulic Style 177 or 77 flexible couplings joined in tandem for increased expansion. Joint movement and expansion capabilities dependent on number of couplings/nipples used in the joint. Pressure rating dependent on size and style of flexible couplings used. Victaulic Style 155.

   c. Expansion Loops: Pipe bends and loops in grooved piping systems shall consist of (8) Victaulic Style 177, 77 or W77 flexible couplings, (4) Victaulic 90° elbows, and (3) grooved end pipe spools provided in water systems to +250°F in accordance with the

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latest Victaulic recommendations for expansion compensation. Rigid couplings shall not be used on loop corners.

d. Expansion Joints: Provide pipe expansion joints at all building expansion joints. Utilize a seismic expansion fitting similar to Metra-Flex, Metra Loop Grooved ends or equal. The expansion fitting shall provide absorbtion in the lateral offset and angular movement.

10. Glycol/Make-up Pump - Provide a packaged automatic glycol solution make up unit consisting of a base, polyethylene reservoir with removable lid and visible solution level scale in gallons, y-stainers, isolation valves, fill pump with a minimum capacity of 5 gpm @ 100 psi discharge, open drip proof motor, pump isolation, check and balancing valves, discharge pressure gauge, motor contactor, pressure control and necessary interconnectiong piping. Pump shall be a bronze gear driven design and shall have a standard 120 volt power electrical cord and all necessary controllers and safeties. The unit shall provide alarm outputs for BMS connection.

11. AIR and DIRT SEPARATORS - Air and dirt removal device shall be constructed of steel. It shall be designed, fabricated and stamped per ASME Section VIII Division 1 with a maximum working pressure of 125 psi at 270°F. Manufacturer shall be holder of ASME U stamp. Manufacturer to have optional 250 psi and 150 psi ASME units available. Units up to three 3-inch in size shall be provided with threaded connections as standard. Units four 4-inch and larger shall be provided with flanged system connections as standard. Inlet and outlet connections to be inline with piping system. Both inlet and outlet to be in the same horizontal and vertical planes. Each air and dirt removal device shall be equipped with a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. The air vent shall be able to be closed to allow flushing and purging of dirt via side port without dirt passing through vent on initial system fill. A brass flushing cock shall be located on the side of each separator to facilitate system fast-fill and removal of the floating impurities from the air system interface within the separator. A blow down valve shall be provided by the unit manufacturer on the bottom of each unit to allow blow down and cleaning. On units 2 ½" and smaller the valve and all of its fittings shall be 1". On units three 3" and larger the valve and all openings shall be 2".

2.07 ROOF TOP UNITS WITH ENERGY RECOVERY (Refer to Section 018100 Commissioning for additional contract requirements)

A. Manufacturers

1. Subject to compliance with requirements specified here within provide rooftop units as manufactured by Valent, Greenheck, Aaon or approved

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equal by the engineer. (Rooftop Unit must fit within the footprint shown on the drawings with manufacturer's recommended service clearances and code mandated airstream clearances being maintained)

2. Any substitution or submitted equal unit that differs from the basis of design must fit within the equipment footprint shown on the Drawings and must be similar in weight (within 10 percent). Any modifications to the design, as a result of approving a such equal or substitution from the basis of design equipment, shall be the responsibility of this subcontractor. Any additional cost to this subcontractor or any other contractor, directly or indirectly, as a result of such approval, shall be the responsibility of this subcontractor

B. General

1. Units shall be of the configuration, capacity, and style as indicated on the drawings and Equipment Schedule and as specified herein. Through properly designed access; ease of maintenance, removability of components, and unit serviceability shall be assured.

2. The unit shall be constructed for outdoor installation. Outdoor unit to be provided with weatherproofing outside air intake hood and shutoff dampers for supply, return and exhaust.

3. The Rooftop unit as a whole and not individual components must be Mass approved and on the Massachusetts Board of Registration of Plumbers and Gas Fitters as a listed and accepted manufacturer.

C. General Description

1. Furnish as shown on plans. Unit performance and electrical characteristics shall be per the job schedule.

2. Provide the unit with the following sections as a minimum:

a. Modulating exhaust fan/economizer section

b. Filter sections

c. Modulating supply fan section

d. Modulating hot water coil

e. Access sections

f. Modulating cooling coil section

g. Stainless steel interior

h. Discharge/intake plenums

i. Modulating condensing unit section

j. Modulating hot gas reheat coil

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k. Modulating energy recovery wheel

l. Outside air weather hood with aluminum mesh screen

3. The complete unit shall be ETL listed.

4. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Units shall be of a modular design with factory installed access sections available to provide maximum design flexibility.

5. Unit is to be shipped factory assembled in one complete section, when possible. Each unit shall be either completely factory assembled and shipped in one piece or split at the condensing section and/or split between the supply fan section and the heat section. Packaged units shall be shipped fully charged with Refrigerant R410A. Units split between the evaporator and the condensing sections are shipped with a nitrogen holding charge only. Unit manufacturer and subcontractor shall coordinate ship split and field installation, refrigerant charging, and all unit field inter-connection requirements.

6. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include final balancing of the supply and return fan assemblies, a refrigeration circuit run test, a unit control system operations checkout (for controls provided with unit), a unit refrigerant leak test and a final unit inspection.

7. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

8. The Rooftop unit shall be designed, manufactured, and independently tested, rated, and certified to meet the seismic standards of the 2009 International Building Code and ASCE 7-06.

   a. Certificates of Compliance shall be provided with the submittal and include the manufacturer's identification, designation of certified characteristics, and the Independent Certifying Agency's name and report identification.

   b. Clear installation instructions shall be provided including all accessory components.

9. Performance: All scheduled capacities and face areas are minimum accepted values. All scheduled amps, kW, and hp are maximum accepted values that allow scheduled capacity to be met.

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10. Warranty: The manufacturer shall provide 12-month parts only warranty. The manufacturer will provide extended five year, parts only, warranty on the compressors. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence upon project completion date.

D. Cabinet, Casing and Frame

1. Provide double-wall construction for all side wall access doors and floor areas shall be provided with 17 gauge exterior and 22-gauge interior, solid G60 galvanized steel construction. Inner liners shall protect insulation during service and maintenance. Unit cabinet shall be designed to operate at total static pressures up to 6.5 in. s w.g.

2. Insulation on ceiling and end panels shall be secured with adhesive and mechanical fasteners. Stainless steel liners shall be provided throughout, allowing no exposed insulation within the air stream.

3. All cabinet insulation, except floor panels, shall be a nominal 2 in. thick, 1½-lb. density, R6.5, glass fiber. A combination of solid and perforated galvanized steel liners shall be provided throughout. Perforated liners to be used in the supply and return air plenums to provide improved sound attenuation. Insulation under perforated liners shall be coated with hospital grade liner rated in accordance with standard ASTM C-1071.

4. All floor panels shall include double wall construction and include a nominal 2 in. thick, 3 lb. density, R4.2 per in. glass fiber insulation.

5. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat, color to selected by architect, provide sample selection chart. Finished surface shall withstand a minimum 1000-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance. Service doors shall be provided on both sides of each section in order to provide user access to all unit components.

6. Service doors shall be constructed of heavy gauge galvanized steel with a gauge, galvanized steel interior liner. All service doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system that is operated by a single, flush-mounted handle. The latch system shall feature a staggered engagement for ease of operation. Removable panels, or doors secured by multiple, mechanical fasteners are not acceptable.

7. The unit base frame shall be constructed of 13-gauge pre-painted galvanized steel. The unit base shall overhang the roof curb for positive water runoff and shall have a formed recess that seats on the roof curb gasket to provide a positive, weather-tight seal. Lifting brackets shall be provided on the unit base with lifting holes to accept cable or chain hooks.

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E. Supply and Exhaust Fans (As Scheduled)

1. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease-lubricated ball bearings shall be used. Bearings shall be sized to provide an L-50 life at 200,000 hours. The entire fan assembly shall be isolated from the fan bulkhead and mounted on spring isolators with seismic restraints.

2. Adjustable pitch V-belt drives with matching belts or direct drive fans shall be provided. V-belt drives shall be selected at manufacturer's standard service factor of 1.5 times fan brake horsepower.

3. Fan motors shall be heavy-duty 1800 rpm open drip-proof (ODP) type with grease-lubricated ball bearings. Motors shall be premium efficiency inverter rated and meet applicable EPACT/NEMA requirements. Motors shall be mounted on an adjustable base that provides for proper alignment and belt tension adjustment. Provide AEGIS magnetic bearing protection ring for all inverter rated motors that are controlled by variable speed drives. The bearing protection ring shall channel harmful shaft voltages to ground to protect bearing races from pitting.

4. Airfoil type supply and return (exhaust) fans - supply fans shall be double width, double inlet (DWDI) airfoil centrifugal fan. All fans shall be mounted using shafts and hubs with mating keyways. Fans shall be Class II type and fabricated from heavy-gauge aluminum. Fan blades shall be continuously welded to the back plate and end rim. The supply air fan and return air fan sections shall be provided with an expanded metal belt guard.

F. Variable Air Volume Control

1. Provide variable frequency drive for the supply and exhaust air fan. Two independent drives, one per fan, shall be provided. Each drive shall be factory installed downstream of the filters in a manner that the drive(s) are directly cooled by the filtered, mixed air stream. Drives shall meet UL Standard 95-5V and the variable frequency drive manufacturer shall have specifically approved them for plenum duty application. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly complete with a single handle latch mechanism. Mounting arrangements that expose drives to high temperature, unfiltered ambient air is not acceptable.

2. The unit manufacturer shall install all power/control wiring. A manual bypass contactor arrangement shall be provided. The arrangement will allow fan operation at full design cfm, even if the drive has been removed for service. 3% Line reactors shall be factory installed for each drive.

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Variable frequency drives shall be equipped with features as indicated in Division 26 00 01 Variable Frequency Drive specification requirements.

3. The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel. The supply and return/exhaust fan drive outputs shall be independently controlled in order to provide the control needed to maintain building pressure control. Supply and return/exhaust air fan drives that are slaved off of a common control output are not acceptable.

4. All drives shall be factory run tested prior to unit shipment.

G. Electrical

1. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with unit shall be numbered and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, high temperature sensor, and a 115-volt receptacle with a separate electrical connection shall also be provided with unit.

2. Each compressor and condenser fan motor shall be furnished with contactors, current sensing manual motor and short circuit protection, and inherent thermal overload protection. Supply and return fan motors shall have Circuit breakers and built in overload protection with VFDs. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance. All 115–600 voltage wire shall be protected from damage by raceways or conduit.

3. A factory installed and wired marine service light, with switch and receptacle, shall be provided in the supply air and return/exhaust fan section. The separate, main unit service receptacle electrical circuit shall also power the light circuit.

4. A factory installed and wired 115 volt power supply shall be provided for the GFI receptacle. The power supply shall be wired to the line side of the disconnect so the receptacle is powered when the main unit disconnect is off. This option shall include a weather proof transformer and disconnect for the 115 volt GFI. The 115 volt GFI electrical circuit shall complete with primary fused short circuit protection.

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5. Phase failure and under voltage protection on three-phase motors shall be provided to prevent damage from single phasing, phase reversal, and low voltage conditions.

6. Ground fault protection shall be provided to protect against arcing ground faults.

7. Smoke detectors shall be field installed as shown on the drawings. Smoke detectors shall be furnished and wired to the building Fire Alarm system by the Division 26 00 01 Subcontractor and installed by the HVAC Subcontractor and ATC Sub-subcontractor shall wire to shut down unit upon activation.

8. Disconnect switches shall be provided by Division 26 00 01.

H. Cooling Sections

1. The cooling coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with factory piped cooling coil and sloped stainless steel drain pan. Hinged access doors on both sides of the section shall provide convenient access to the cooling coil and drain pan for inspection and cleaning.

2. Submittals must demonstrate that scheduled unit leaving air temperature (LAT) is met, that fan and motor heat temperature rise (TR) have been considered, and scheduled entering air temperature (EAT) equals mixed air temperature (MAT). Draw-through cooling—Scheduled EAT equals cooling coil EAT and scheduled unit LAT equals cooling coil LAT plus TR.

3. Direct expansion (DX) cooling coils shall be fabricated of seamless ½ in. diameter high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a maximum of 12 fins per in. All units shall have two independent refrigerant circuits and shall use an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water. Coils shall have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.8 - 1.2 mil on all surface areas including fin edges. Superior hardness characteristics of 2H per ASTM D3363-92A and a cross-hatch adhesion of 4B-5B per ASTM B3359-93. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117-90.

4. A stainless steel, positively sloped drain pan shall be provided with the cooling coil. The drain pan shall extend beyond the leaving side of the coil

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and underneath the cooling coil connections. The drain pan shall have a minimum slope of 1/8 in. per foot to provide positive draining. The drain pan shall be connected to a threaded drain connection extending through the unit base. Units with stacked cooling coils shall be provided with a secondary drain pan piped to the primary drain pan. Drain pan connections shall be field traped per manufacturer's instructions and piped to the nearest roof drain to prevent ponding on the roof.

I. Hot Water Coils - Primary surface shall be round seamless 5/8 inch O.D. by 0.025 inch thick copper tube on 1.5-inch centers, staggered in the direction of airflow. All joints shall be brazed.

1. Secondary surface - Secondary surface shall consist of 0.0075 inch rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Bare copper tube shall not be visible between fins and the fins shall have no openings punched in them to accumulate lint and dirt. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates.

2. Casings - Casings shall be constructed of continuous stainless steel with 3/8" diameter boltholes for mounting on 6" centers. Coil side plates shall also be of continuous galvanized steel of reinforced flange type for greater strength and ease of stacking coils in banks.

3. Coils - Coils shall have equal pressure drop through all circuits. Coils shall be circuited for counter flow heat transfer to provide the maximum mean effective temperature difference for maximum heat transfer rates. The use of internal restrictive devices to obtain turbulent flow will not be acceptable as they prevent complete drawing of the coil and give high water pressure drop. All coils exceeding 45" FL shall be furnished with four fin angles to properly position the coil core

4. Water Headers - Headers on coils shall be of non-ferrous materials using seamless copper tubing. The headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility. Vent connections shall be provided at the highest point to assure proper venting.

5. Connections - The hot water coil connection will be a copper sweat type.

6. Tests - The complete coil core shall be tested with 315 psig air pressure under warm water and be suitable for operation at 250 psig working pressures. Individual tube tests and core tests before installation of headers shall not be considered satisfactory. Water-cooling coils shall be circuited for drainability. Use of internal restrictive devices to obtain turbulent flow

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shall not be acceptable. Vents and drains shall be furnished on all water coils. Coils shall be rated in accordance with ARI standard 410.

7. Installation - Coils shall be mounted in stainless holding racks. Water coil supply and return connections shall be extended to the unit exterior. Water coil drain and vent connections are accessible from the interior of the unit and are not extended.

8. All coils including primary and secondary surfaces and headers shall have a factory applied corrosion resistant coil coating such as Electrofin e-coat with a flexible epoxy polymer coating process.

J. Filters

1. Unit shall be provided with filter sections. The filter sections shall be supplied complete with the filter rack as an integral part of the unit. The draw-through filter section shall be provided with panel and cartridge filters.

2. Filters shall be frame mounted and shall slide into galvanized steel racks contained within the unit. Filters shall be installed in an angular arrangement to maximize filter area and minimize filter face velocity. Filters shall be accessible from both sides of the filter section.

3. Four inch deep MERV 13, efficient, UL Std. 900, Class 1, AmericanAirFilter cartridge filters shall be provided. Two inch. panel, MERV-8 efficient pre-filters shall be included. Aluminum mesh outside air filter shall be provided at the outside air hood inlet. Cartridge filters shall consist of filter media permanently attached to a metal frame and shall slide into a gasketed, extruded aluminum rack contained within the unit. The filter rack shall have secondary gasketed, hinged end panels to insure proper sealing. Filters shall be accessible from both sides of the filter section. Filter set quantities shall be provided as indicated in Part III.

4. Clogged filter switches and magnehelic gauges shall be provided on all filter sections.

K. Outdoor / Return Air Section

1. Return Air Plenum- Unit shall be provided with a return air plenum capable of handling 100 percent re-circulated air. The 100 percent return air plenum shall allow return air to enter from the bottom of the unit. Low leak dampers shall be provided. Damper blades shall be fully gasketed and side sealed and arranged vertically in the hood. Damper leakage shall be less than 0.2 percent at 1.5 in. static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers. Control of the dampers shall be from a field installed modulating actuator provided by the ATC Sub-subcontractor.

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L. Energy Recovery Section and Components (As Scheduled)

1. Unit shall be provided with a modulating outdoor air economizer section with an ARI certified total energy recovery wheel with a minimum of 65% effectiveness. The economizer section shall include outdoor, return and return exhaust air dampers. Actuators shall be provided by the ATC contactor.

2. Outdoor air shall enter at the back of the section through a factory-installed hood capable of handling 100 percent outdoor air. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same pre-painted finish as the main unit. The hood shall include a bird screen to prevent infiltration of foreign material and a rain lip to drain water away from the entering air stream. Return air shall enter through the bottom of the unit.

3. The entire section shall be double-wall construction.

4. The enthalpy wheel shall be constructed of corrugated synthetic fibrous media, with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Rotors with desiccants coated, bonded, or synthesized onto the media are not acceptable due to delamination or erosion of the desiccant material. Media shall be synthetic to provide corrosion resistance and resistance against attack from laboratory chemicals present in pharmaceutical, or hospital environments as well as attack from external outdoor air conditions. Coated aluminum is not acceptable. Face flatness of the wheel shall be maximized (+/–0.032 in.) in order to minimize wear on inner seal surfaces and to minimize cross leakage. Rotor shall be constructed of alternating layers of flat and corrugated media. Wheel layers should be uniform in construction forming uniform aperture sizes for airflow. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate internal wheel bypass. Wheel layers that can be separated or spread apart by airflow are unacceptable due to the possibility of channeling, internal bypass or leakage, and performance degradation. The media shall be in accordance with NFPA or UL guidelines. The desiccant material shall be a molecular sieve, specifically a 4A or smaller molecular sieve to minimize cross contamination. The wheel frames shall consist of evenly spaced steel spokes, galvanized steel outer band and rigid center hub. The wheel construction should allow for post fabrication wheel alignment. The wheel seals shall be brush seals, neoprene bulb seals, or equivalent. Seals should be easily adjustable. Cassettes shall be fabricated of heavy duty reinforced galvanized steel. Cassettes shall have a built-in adjustable purge section minimizing cross contamination of supply air. Bearings shall be in board, zero maintenance, permanently sealed roller bearings, or alternatively, external flanged bearings.

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5. Drive systems shall consist of fractional horsepower A.C. drive motors with multilink drive belts. The wheel shall be tested in accordance with NFPA or UL guidelines and shall be UL recognized or equivalent.

6. The wheel capacity, air pressure drop, and efficiency shall be ARI certified by ARI and its testing agencies. Alternative independent performance testing must be pre-approved to be accepted.

7. Wheel shall be provided with variable speed control shaft grounding rings for frost protection. Provide energy recovery wheel defrost controls and rotation detection controls.

8. The wheel recovers energy from the factory-supplied return exhaust section and includes an airfoil fan and motor in accordance with construction already specified. Gravity relief dampers and fold-out exhaust hood shall be provided.

9. All necessary exhaust fan motors, branch short circuit protection, and wiring shall be provided.

10. Two-in., 30 percent pleated filters shall be provided in both air inlets to protect the wheel from dust and dirt in both the outdoor and return/exhaust air paths. Dampers to be low-leak type, and shall be provided on outdoor or return dampers. Damper blades shall be fully gasketed and side sealed and arranged horizontally in the hood. Damper leakage shall be less than 0.2 percent at 1.5 in. static pressure differential. Leakage rate to be tested in accordance with AMC Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers.

M. Access Sections - Unit shall be provided with factory installed access sections located as shown/indicated on the drawings. Access sections shall have hinged access doors on both sides of the section and shall have the same construction features as the rest of the unit.

N. Discharge and Return Plenum - A supply air discharge and return plenum shall be provided. The plenum section shall be lined with a perforated acoustic liner (rated per ASTM C1071 Standards) to enhance sound attenuation. The plenum section shall have a bottom discharge opening. Isolation dampers shall be provided in the bottom return air opening and bottom supply air openings. Actuators shall be provided by the ATC Sub-subcontractor to close the dampers when the fans are not running.

O. Condensing Unit

1. The condensing section shall be open on the sides and bottom to provide access and to allow airflow through the coils. Condenser coils shall be multi-row and fabricated from cast aluminum micro-channel coils. Each condenser coil shall be factory leak tested with high-pressure air under

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water. Coils are to be recessed so that the cabinet provides built in hail protection.

2. Condenser fans shall be direct drive, ECM motor driven, propeller type designed for low tip speed, with low noise fan blades and vertical air discharge. Condenser fan rpm shall be 1140 rpm maximum. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motors shall be heavy-duty, inherently protected, three-phase, non-reversing type with permanently lubricated ball bearing and integral rain shield. Provide condenser fan blades that reduce radiated sound levels.

3. Each circuit shall have fan cycling of at least one condenser fan to maintain positive head pressure. An ambient thermostat shall prevent the refrigeration system from operating below 45º F.

4. Liquid tight conduit shall be provided on exposed condensing section wiring.

5. Compressors- Each unit shall have multiple, heavy-duty Copeland digital or staged scroll compressors. Each compressor shall be complete with crankcase heater, sight-glass, anti-slug protection, current sensing and motor temperature sensing, motor overload protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Compressors shall be isolated with resilient rubber isolators to decrease noise transmission. At a minimum 50% of the quantity of compressors shall be a variable/digital scroll compressor.

6. Refrigeration Controls - Each unit shall have two independent refrigeration circuits. Each circuit shall be complete with low pressure control, filter-drier, liquid moisture indicator/sight-glass, solenoid, thermal expansion valve, liquid line shutoff valve with charging port, discharge line shutoff valve, a manual reset high pressure safety switch and high pressure relief device. The thermal expansion valve shall be capable of modulation from 100 percent to 25 percent of its rated capacity. Sightglasses shall be accessible for viewing without disrupting unit operation. Each circuit shall be dehydrated and leak tested.

7. Capacity Control- Refrigeration capacity control shall be accomplished by staging of the unit's multiple compressors and modulating the scroll compressor utilizing a degree time staging method or modulating a digital scroll compressor. To maintain desired temperature control, the unit shall have a capacity control consisting of staged compressors of quantities indicated on schedules and a minimum of one digital scroll compressor or inverter driven compressors or control logic and staging methods for capacity modulating. The units condenser section fan speed shall be modulated based upon unit loading.

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8. All compressor capacity control staging shall be controlled by the factory installed main unit control system.

9. Modulating hot gas reheat shall be provided on the lead circuit complete with modulating valves, micro-channel refrigerant reheat coil, and dehumidification control. Controls shall maintain ± .5 deg. F control of the reheat coil leaving air temperature.

P. Roof Curb – refer to Section 23 05 48

Q. Controls

1. General – Automatic Temperature controls for Rooftop unit shall be DDC (direct digital control type). The RTU shall come stripped of any controls. All sensors, actuators, controls (with exception of RTU gas-heating and DX cooling safety and internal refrigeration system controls) shall be provided by the ATC/DDC controls Sub-subcontractor.

2. Unit manufacturer shall provide terminal strips for all control devices not furnished by ATC Sub-subcontractor. Including but not limited to modulating gas valve, compressor capacity controls, and hot gas subcool and reheat control.

3. Refer to Specification 23 00 01 ATC control specification requirements and Control Diagram Drawings for Rooftop unit control requirements and expanded sequence of operation and required points list.

4. HVAC and ATC Contractors shall coordinate with unit manufacturer to ensure all sequence of operation and control points are achieved with the BMS to complete the specified sequence of operation and points lists.

5. RTU manufacturer shall provide the necessary time and documentation to the ATC sub-subcontractor to provide seamless communication and points to achieve the desired sequence and BMS interface.

2.08 TERMINAL HEATING UNITS (HYDRONIC)

A. Finned Tube Radiation:

1. General: Provide finned tube radiation of lengths and in locations as indicated, and of capacities, style, and having accessories as scheduled.

2. Cabinets: Minimum 18-ga cold-rolled steel full backplate, minimum 14-ga front. Brace and reinforce front minimum of 4 ft.-0 in. o.c. without visible fasteners.

3. Elements: Copper tube and aluminum fins, or steel tube and steel fin (as scheduled) with tube mechanically expanded into fin collars to eliminate noise and insure durability and performance at scheduled ratings.

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4. Finish: Flat black heat resisting paint for backplate; factory finished baked enamel on fronts and accessories. Submit color selection chart to Architect as part of submittal package.

5. Accessories:

   a. End panels, inside and outside corners, and enclosure extension.

   b. Access panels in front of valves, balancing cocks, and traps.

   c. Factory-mounted dampers.

   d. Ball bearing hangers.

6. Manufacturer: Subject to compliance with requirements, provide finned tube radiation of one of the following:

   a. Vulcan Corp.

   b. Rittling

   c. Sterling Radiator; Div. of Reed National Corp.

   d. Or equal

2.09 METAL DUCTWORK

A. Reference Standards: Material, construction and installation shall meet requirements of most recent editions of the following standards and references, except for more stringent requirements specified or shown on Drawings:

Standard	As Applicable To:
SMACNA HVAC Duct Construction Standards Metal and Flexible	Sheet Metal Ductwork; Duct Liners; Adhesives; Fasteners; Flexible Ductwork.
SMACNA HVAC Air Duct Leakage Test Manual	Duct Leakage Testing
SMACNA Fibrous Glass Duct Construction Standards	Fibrous Glass Ductwork; Tapes
SMACNA Thermaoplastic Duct (PVC) Construction Manual	PVC Ductwork

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ADC and TIMA Flexible Duct Performance Standards	Flexible Ductwork
NFPA 96	Kitchen Hood Exhaust Ductwork
NFPA 45	Laboratories using chemicals
SMACNA Guidelines for Welding Sheet Metal	Welded Galvanized, Black Iron and Stainless Steel Ductwork

B. General

1. Provide supporting and hanging devices necessary to attach entire HVAC system including ductwork and equipment, and to prevent vibration.
2. Provide vertical and horizontal supports as required by codes to meet minimum applicable earthquake resistance standards.
3. Ductwork shall be free from vibration under all conditions of operation. Dimensions shown on Drawings for lined ductwork are net inside dimensions. Increase ductwork to accommodate lining requirements.
4. Pipe or conduit crossing duct:
   a. No pipe, conduit, hanger, Architectural element nor structural member shall pass through duct without Designer's written approval.
   b. Where it is impossible to re route pipe or conduit and when written approval has been obtained, increase duct size to maintain constant cross sectional area at point of interference. Provide streamlined enclosure for pipe or conduit, as illustrated in SMACNA.
5. When making offsets and transformations necessary to accommodate structural conditions, preserve full cross sectional area of ductwork shown on Drawings.

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6. Ductwork shall have pressure velocity classifications as follow:

DUCT CONSTRUCT-ION CLASS	STATIC PRESSURE RATING	PRESSURE	SMACNA SEAL CLASS	SMACNA LEAKAGE CLASS	VELOCITY
4"	4"	Pos.*	A	3	4000 fpm or less
3"	3"	Pos. or Neg.	A	3	4000 fpm or less
2"	2"	Pos. or Neg.	A	6	2500 fpm or less
1"	1"	Pos. or Neg.	A	6	2500 fpm or less
½"	½"	Pos. or Neg.	A	6	2000 fpm or less

*for negative pressures over 3" w.g., refer to SMACNA Round and Rectangular Industrial Duct Construction Standards for joint and intermediate reinforcement requirements.

a. Unless otherwise specified or shown on the drawings, the following pressure classifications shall be used for the types of ductwork listed below:

1) 4" Class: All supply ductwork from discharge of air units to inlets of supply diffusers and/or variable air volume units.

2) 3" Class: All exhaust and system return ductwork. Supply ductwork after the variable air volume units.

3) 2" Class: All other ductwork.

7. Sealing Requirements for Class A, Leakage Class 3 & 6 Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel Ductwork:

a. Transverse Joints

1) During assembly seal all flanged transverse joints with sealing tape of quality equal to Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures. After sealant has cured, seal entire joint with Hardcast Inc.

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RTA-50 adhesive on to Hardcast Inc. DT tape or approved equal.

2) Seal all non-flanged transverse joints with Hardcast Inc. RTA-50 adhesive on to Hardcast Inc. DT tape or approved equal.

b. Longitudinal Seams

1) Seal all longitudinal seams during ductwork fabrication with Hardcast Inc. Cold Seal 1001 or approved equal.

c. Joints and Ductwall Penetrations

1) Seal all duct joints at takeoffs, access doors, damper bearing penetrations, flexible duct connections etc., with Hardcast Inc. Versa Grip 102 or approved equal.

2) Note, access doors and damper rod penetrations shall be equipped with proper hardware for sealing.

8. Support

a. Space hangers as required by SMACNA (8 ft max) for horizontal duct on 8 ft. centers, unless concentrated loadings require closer spacing.

b. Support vertical duct on each floor or slab it penetrates.

c. Supports for ductwork and equipment shall be galvanized unless specified otherwise.

9. Connections

a. Connect inlets and outlets of air handling units and fans to ductwork with flexible connections unless fan has vibration isolator mounts inside unit with flexible connections and no external vibration isolators. Exception: Do not use flex on life safety smoke exhaust fans.

b. Indoors, flexible connections shall be neoprene coated fibrous glass fire retardant fabric, by Ventfabrics, or Durodyne. Outdoors, flexible connections shall be Dupont hypalon coated fibrous glass fire, weather, and UV resistant by Ventfabrics or Durodyne.

c. Secure flexible connections tightly to air handlers with metal bands. Bands shall be same material as duct construction.

d. Connections from trunk to branch ducts shall be as detailed on Drawings.

10. Construction

a. No sharp metal edges shall extend into air streams.

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b. Install drive slips on air leaving side of duct with sheet metal screws on 6" centers.

c. Spin in collars shall NOT be used for branch connections in 3" or higher pressure class ductwork.

11. Joints

a. Longitudinal lock seams shall be double locked and flattened to make tight joints.

b. Make transverse joints, field connections, collar attachments and flexible connections to ducts and equipment with sheet metal screws or bolts and nuts. Do not use rivets and staples.

12. Prefabricated Transverse Duct Joints

a. Transverse joints in galvanized sheet metal ductwork may be made with galvanized gasketed frame and angle duct joint system by Ductmate, TDF, TDC or approved equal. Angles shall be at least 20 gauge. Prefabricated transverse duct joints shall not be used for duct 16 GA. and heavier, nor for duct 23 GA. or lighter.

b. Secure angles to duct with screws (using clutched arbor) or spot welds spaced as recommended by manufacturer for duct pressure class.

13. Elbows and Bends

a. Elbows and bends for rectangular ducts shall have centerline radius of 1 1/2 times duct width wherever possible. Elbows for grease exhaust and fume hood exhaust shall be full radius. Vanes or mitered duct are not allowed.

b. Where centerline radius is less than 1 1/2 times duct width (on supply, return and exhaust ductwork), elbows shall be radius throat (square throat allowed when turning around column or other close objects) with radius heel. For elbows whose width is greater than 48 inches and/or where shown on plans, provide splitter vanes. Install vanes in accordance with SMACNA. Where multiple elbows are separated by less than ten duct diameters use splitter (full length) vanes.

c. For round ductwork provide stamped elbows, with centerline radii equal to 1 1/2 times duct diameter, or gored elbows as follows:

Elbow Angle	No. of Gores
0° - 36°	2
37° - 72°	3
73° - 90°	5

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d. Elbows for flat oval ducts shall have centerline radii equal to 1 1/2 times duct diameter in plane of bend, or gored elbows with gores as specified for round ducts.

14. Access Panels/Doors

a. Provide proper pressure and leakage rated, gasketed, duct mounted access panels/doors for the following items with minimum sizes, as indicated. Access doors shall be of double wall construction doors in insulated ducts shall be insulated. Gauges of door materials, no. of hinges, no. and type of door locks shall be as required by the SMACNA Duct Construction Standards. Hinged doors are not acceptable, screwed or bolted access panels are not acceptable. Doors shall be chained to frame with a minimum length of 6" to prevent loss of door. For seal Class A, access doors shall be leakage rated, neoprene gasketed UL 94 HF1 listed, DUCTMATE "sandwich" or approved equal. Door metal shall be the same as the attached duct material. For grease and high temperature ducts, door assembly shall be rated for 2300°F. The minimum sizes are:

1) Fire dampers 12" x 12", or larger.

2) Combination Fire/Smoke dampers 12" x 12", or larger.

3) Smoke dampers 6" x 6" minimum.

4) Automatic control dampers 6" x 6" minimum.

5) Manual volume dampers 2 sq. ft. and larger 6" x 6" minimum.

6) Inlet side to all coils 12" x 12", or larger.

7) Suction and discharge sides of inline fans 24" x 24" minimum.

8) At additional locations indicated on drawings, or specified elsewhere 12" x 12" minimum.

b. Generally access doors are not shown on the drawings, but shall be provided in accordance with the above.

15. Extractors shall have adjusting rod and locknut on outside of duct.

16. Connections to roof fans:

a. Shall be at least 22 ga. galvanized steel soldered watertight.

b. Solder side seams at least 12" up from bottom.

c. Provide suitable dielectric gaskets to join dissimilar materials.

17. Plenums and connections to louvers:

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a. Shall be 18 ga. minimum cross broken and properly reinforced with galvanized angle irons to SMACNA requirements.

b. Shall have bottom and corner seams soldered watertight at least 12" up from bottom.

c. Shall have neoprene gaskets or other non corrosible material to make connections to louvers watertight.

d. Shall pitch connection back towards the louver. Provide half coupling drain connection at bottom of plenum unless noted otherwise. Pipe drain to nearest floor drain.

e. Shall have unused portions of louvers blocked-off with sheet metal; sealed air and water tight; insulated with 2" thick 6 lb. density rigid or board insulation.

18. Duct Pressure Tests

a. Pressure test all duct classes after takeoffs and wall penetrations are in place and before applying exterior insulation. Correct any leaks.

b. Pressure and leak test 100% of all duct work with a pressure class of 3" or higher as specified in paragraph 2.20.B.6.a. Duct shall be constructed so there is no joint or structural failure at the test pressure.

19. Duct Leakage Tests

a. Leak testing method shall be performed as outlined in the SMACNA HVAC Air Duct Leakage Test Manual. As specified in paragraph 2.20.B.6 & a, utilize Sealing Requirements for Class A and Leakage Class 6 for all ductwork. Provide orifice assembly including straightening vanes, orifice plate mounted in straight tube with properly located pressure taps, and U tube manometer or other device as specified by SMACNA. Orifice assembly shall be calibrated accurately and shall come with calibration curve. Leakage classes shall be as previously specified. Submit leak test report (per SMACNA format) for Designer review. Drawings of ductwork tested shall also be submitted with report, indicating presence of takeoffs, wall penetrations, joints, etc.

20. Materials

a. Sheet metal ducts shall be constructed of hot dipped galvanized sheet metal with G90 Commercial coating according to ASTM 527 unless specified otherwise.

b. Stainless steel (SS) ductwork shall be 18 gauge for kitchen hoods; and as required by SMACNA for other ducts. Materials shall be

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316/No. 4 finish for exposed duct, 304/No. 1 finish for concealed ducts. Joints and seams shall be welded as required by SMACNA Guidelines for Welding Sheetmetal.

c. Aluminum ductwork shall be Alclad 3003 1414 or alloy 5052 H32, for exhaust fan No. 2 duct system. Thickness as required by the SMACNA duct construction standards with Alloy 6061 bracing angles, and Pittsburgh lock longitudinal corner and double side seaming.

d. Flexible Ductwork

1) Flexible ductwork, connecting to uninsulated or unlined duct, shall be polyester core with corrosion resistant helical wire reinforcing. The polyester core shall be minimum two ply and shall have a minimum thickness of 0.0017". Flex duct shall be U.L. rated for 6" W.C. positive pressure, 2" W.C. negative pressure with a maximum velocity of 4000 FPM. Flexduct must be listed as a Class 1 Connector according to UL 181 and shall meet the requirements of NFPA 90A maximum ASTM E 84 fire hazard rating shall be 25 flame spread, 50 fuel contributed and 50 smoke developed. Uninsulated flexible duct shall be equivalent to Wiremold, Type WB, or Flexmaster Types 2 and 4 (not type 9).

2) Flexible duct connected to insulated or lined duct shall also be insulated and shall be equivalent to Wiremold Type WK or Flexmaster Types 2 or 4 (not type 9), with 1 1/2", 3/4 lb. density fiberglass insulation and an aluminized reinforced vapor barrier.

3) Submittals shall include data on no. of polyester plies and minimum thickness of polyester core, in addition to other data listed above required to ensure that submitted product meets the requirements of these specifications.

4) If flexduct other than the model numbers of the vendors listed above is submitted, a sample of the flex shall be submitted to the Designer. The Designer shall have sole discretion in determining whether the submitted flex is equivalent to that of the named vendors above.

5) Unless otherwise indicated, flexible duct shall not exceed 5'-0" long.

C. 2" and Lower Pressure Class Ductwork, Rectangular:

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1. Ducts wider than 19" with more than 10 square feet of unbraced panel shall be beaded or cross broken.
2. Internal stiffening struts shall only be used upon prior written approval of the Designer.
3. Make changes in duct size with tapered connections as required by SMACNA. Changes shall NOT exceed 30°from line of air flow. Take off to the diffusers shall be 45° leading edge type or Bellmouth type.
4. Transverse joints shall be TDF/TDC or slip joints; use flat or standing seam according to SMACNA. Where duct size requires standing seam but space restrictions dictate flat seam, notify Designer prior to fabrication.

D. 2" and Lower Pressure Class Ductwork, Round:

1. Joints
   a. Longitudinal joints shall be spiral seam, butt welded, lap and seam welded, or ACME lock grooved seam. Snap lock seams shall be used on ½" w.g. pressure class duct only.
   b. Transverse joints shall be beaded sleeve joint or other approved joints listed in SMACNA. Use three or more sheet metal screws at 15" uniform intervals along circumference of joints.
2. Branch fittings shall be conical tee (Buckley or equal) or combination tee as shown in SMACNA.

E. 3" and 4" Pressure Class Ductwork Rectangular

1. Joints
   a. Joints shall be prefabricated type by TDC, TDF or Ductmate. See Prefabricated Joints paragraph for specific requirements.
2. Duct reinforcement spacing and type shall comply with SMACNA.
3. Ductwork on both sides of transitions shall be run in same horizontal axis.
4. Diverging section slope shall be 1 1/2" per foot or less if possible.
5. Contraction section slope shall not exceed 7" per foot.
6. Takeoffs shall be 45° leading edge type except that Bellmouths (Buckley or equal) may be used for takeoffs to terminal boxes if the distance between the box and point of takeoff is less than 8 ft.
7. Ducts with an aspect ratio greater than 3:1 shall be minimum of 18 gauge unless a thicker gauge is required by SMACNA.

F. 3" and 4" Pressure Class Ductwork, Flat Oval, Single Wall

1. Joints

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a. Ducts shall have spiral lock seams or longitudinal seams. Seams and joints in fittings shall be continuously welded. If coating is damaged during welding, repair joints to prevent corrosion.

b. Transverse joints shall be slip or flanged.

G. 3" and 4" Pressure Class Ductwork, Round, Single Wall

1. Joints

a. Longitudinal seams shall be lock spiral, lock longitudinal or butt welded longitudinal.

b. Transverse joints shall be slip joints. Draw band joints shall be used on longitudinal seam duct only. Loose flange Vanstone joints may be used on ducts over 36" in diameter.

c. Seams and joints in fittings shall be continuously welded. If coating is damaged during welding, repair joints to prevent corrosion.

2. Branch fittings shall be conical tee or combination tee as detailed in SMACNA.

H. Flexible Rigid Duct

1. Flexible ductwork shall be Flexmaster Triple Lock Buck Duct Flexible Air Duct (insulated) as manufactured by Buckley Associates or equal (617 878 5000). Flexible duct, non insulated, shall be Underwriters Laboratory Listed UL 181 Class 0 air duct and constructed in accordance with NFPA Standards 90A and 90B. It shall have a smoke/flame spread rating of 50/25.

2. Duct shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and stability. The joint shall consist of a triple lock mechanically performed without the use of adhesives to make a durable airtight seam. A double lock is not acceptable.

3. Flexible duct connected to insulated or lined duct shall also be insulated. Flexmaster insulated flex shall have a gray Fire Retardant Polyethylene outer jacket with a ½ lb. density, 1 1/2" thick fiberglass insulation blanket, factory wrapped. Flexible Duct, insulated, shall be Underwriters Laboratory Listed and constructed in accordance with NFPA standards 90A and 90B. It shall have a smoke/flame spread rating of 50/25.

4. The flexible duct shall be supported as required.

5. Flexible duct work shall be rated at 12" positive pressure. Duct from 3 to 16" shall have a negative pressure of 12", 8" for duct work 18 and 20.

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6. All flexible duct shall be individually cartoned and labeled for delivery to the job site for maximum protection.

7. Submittals shall include data on minimum thickness of aluminum core, in addition to other data listed above, required to ensure that submitted product meets the requirements of these specifications.

8. Provide sealing compound for installation. See further paragraphs in this specification and details for other installation requirements.

I. Volume Dampers

1. Provide Young Regulator manual adjustable rectangular opposed blade dampers for duct heights less than 12" with factory installed locking hand quadrants extended 2" for all dampers installed in externally insulated duct:

   a. On each supply, return and general exhaust duct take off.

   b. At each take off to register, grille or diffuser (not all are shown on Drawing).

2. Dampers are manufactured approximately 5/16" smaller in width and 1/8" smaller in height than size of duct in which they are installed; e.g., nominal damper size is 24" x 10"; actual size is approximately 23 11/16" x 9 7/8".

3. Damper frame shall be constructed of #6063 extruded aluminum reinforced channel with minimum thickness of .050". Opposed damper blades shall be #6063 extruded aluminum with minimum thickness of .050" and shall include reinforcing ribs. Each blade shall be supported in the damper frame by individual Teflon axle bearings, and shall be driven by stainless steel connecting slide linkage controlled by 3/8" square steel control shaft.

4. Note: All required volume dampers may not be indicated on drawings but dampers shall be provided as necessary for systems balancing.

5. Dampers 12" and larger in height shall be opposed multi blade equal to Greenheck, Nailor, or Vent Products.

6. Where dampers are inaccessible, use Young Regulator locking type ceiling regulators and miter gear or worm gear for all horizontal dampers. Bearing coupling for bottom duct control may be used for shaft on vertical blade dampers. The 3/8" rod between ceiling regulator and damper shall be provided by contractor.

7. Damper blades shall be two gauges heavier than adjoining ductwork, and shall be riveted to supporting rods. Hem over edges parallel to rods.

8. Brackets shall be galvanized metal, secured to ductwork with sheet metal screw with locking quadrant arms (see seal class section for additional

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requirements). Provide 2" handle extension for all dampers on externally insulated ductwork.

9. Note: All required volume dampers may not be indicated on Drawings but dampers shall be provided as necessary for system balancing.

J. Automatic Dampers: Install automatic dampers furnished under Automatic Temperature Control Paragraph of this Section, as shown on Drawings, and as specified. Provide sealed wall penetrations for Seal Class A ductwork.

K. Locker Room Exhaust or Return Ductwork

1. Ductwork shall be aluminum, of types as detailed in this specification above and constructed in accordance with SMACNA except that Seal Class shall be "A" regardless of duct pressure rating.

L. Branch Duct Take off Fittings

1. Contractor shall provide Buckley Bellmouth Take offs at all branch duct locations.

2. Bellmouth Fitting shall be Model BMD with damper. In areas where sufficient duct height is not available, the contractor shall provide the Buckley Mini mouth fitting, Model M BMD with damper or the flat oval Bellmouth, Model FOBMD with damper.

3. Bellmouths shall be constructed of heavy duty galvanized steel. Bellmouths shall include an air tight Neoprene gasket to ensure a tight fitting with minimal leakage. Pre drilled holes shall be provided for quick mounting. Bellmouth shall be as manufactured by Buckley Associates or equal (617 878 5000).

4. Standard damper hardware to be constructed of 26 gauge galvanized material with a quadrant damper and tight fitting gasketing to ensure minimal leakage at damper pivot points.

5. Optional heavy duty hardware shall be provided at locations of higher static pressure where shown on the drawings.

6. Ninety degree take offs are not permitted on this project..

2.10 DUCTWORK ACCESSORIES

A. Dampers:

1. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct construction Standards".

2. Automatic Control Dampers: Refer to Division-23 section "Automatic Temperature Control" for control dampers; not work of this section.

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3. Backdraft Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at .05" static pressure. Construct blades of 16-ga. aluminum, provide 1/2" diameter ball bearings, 1/2" diameter steel axles spaced on 9" centers. Construct from 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under: 4" x 1-1/4" x 16 ga. channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up. Provide felted or rubber trim to assure tight, leak-proof seal when closed.

4. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

   a. Air Balance, Inc.

   b. Airguarde Corp.

   c. American Warming & Ventilating, Inc.

   d. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.

   e. Louvers & Dampers, Inc.

   f. Penn Ventilator Co.

   g. Ruskin Mfg. Co.

   h. Or equal

B. Fire Dampers:

1. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11-ga. galvanized steel. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated. Provide owner with a spare fusible link for each damper. Provide out of air stream type damper in open position and with positive lock in closed position, and with the following additional features:

   a. Damper Blade Assembly: Curtain type.

   b. Blade Material: Steel, match casing.

   c. Blade Material: Stainless steel.

2. Motor-Driven Fire/Smoke Dampers: Provide line voltage motor-driven fire/smoke dampers in types and sizes indicated on drawings, with casing constructed of 11-ga. galvanized steel with bonded red acrylic enamel finish, fusible link 160 to 165 degrees F (71 to 74 degrees C), unless otherwise indicated, and curtain type stainless steel interlocking blades, with electric motor equipped with instant closure clutch, stainless steel cable damper blade linkage, motor mounting bracket, and 32" long wire leads for connecting to smoke detector, and with the following construction features:

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a. Unit Assembly: Motor mounted outside air stream.

3. Manufacturer: Subject to compliance with requirements, provide fire dampers of one of the following:

a. Air Balance, Inc.

b. American Warming & Ventilating, Inc.

c. Arrow Louver and Damper; Div. of Arrow United industries, Inc.

d. Louvers & Dampers, Inc.

e. Penn Ventilator Co.

f. Phillips-Aires

g. Ruskin Mfg. Co.

h. Or equal

C. Turning Vanes:

1. Manufactured Turning Vanes: Provide double thickness airfoil turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set at 2" o.c, and set into side strips suitable for mounting in ductwork.

2. Manufacturer: Subject to compliance with requirements, provide turning banes of one of the following:

a. Aero Dyne Co.

b. Airsan Corp.

c. Anemostat Products Div.; Dynamics Corp. of America.

d. Barber-Colman Co.

e. Duro Dyne Corp.

f. Environmental Elements Corp.; Subs, Koppers Co., Inc.

g. Hart & Cooley Mfg. Co.

h. Register & Grille Mfg. Co., Inc.

i. Souther, Inc.

j. Or equal

D. Duct Hardware:

1. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

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a. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

b. Quandrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2. Manufacturer: Subject to compliance with requirements. Provide duct hardware of one of the following:

a. Ventbabrics, Inc.

b. Young Regulator Co.

c. Or equal

E. Duct Access Doors:

1. General: Provide duct access doors of a size as required to service and maintain device in duct. Provide on (1) access door at each control damper, humidifier, coil, fire damper, and any device that requires attention.

2. Construction: Construct of same or greater gauge as ductwork served, provide insulted doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

3. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:

a. Air Balance, Inc.

b. Duro Dyne Corp.

c. Register & Grille Mfg. Co., Inc.

d. Ruskin Mfg. Co.

e. Ventfabrics, Inc.

f. Zurn Industries, Inc.; Air Systems Div.

g. Or equal

F. Flexible Connectors:

1. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to

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allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

2. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

   a. American/Elgen Co.; Energy Div.

   b. Duro Dyne Corp.

   c. Flexaust (The) Co.

   d. Ventfabrics, Inc.

   e. Or equal

2.11 ACOUSTIC DUCT LINING

A. Lining for Rectangular Metal Ducts: All ducts, where shown on the drawings, shall be lined with 2" thick (minimum R-6) hospital grade liner similar to "Permacote Linacoustic HP" fiberglass duct liner with factory-applied surface and edge coating. The lining can be less than 2” thick as long as code minimum R-6 is met. The liner shall meet the Life Safety Standards as established by NFPA 90A and 90B, FHC 25/50 and Limited Combustibility and the airstream surface coating should contain an immobilized, EPA-registered, anti-microbial agent so it will not support microbial growth as tested in accordance with ASTM G21 and G22. The duct liner shall conform to the requirements of ASTM C 1071, with an NRC not less than .75 as tested per ASTM C 423 using a Type "A" mounting, and a thermal conductivity no higher than .24 at 75EF mean temperature.

B. Material Handling and Storage: Liner shall be kept clean and dry during transportation, storage and installation. Care should be taken to protect the liner from exposure to the elements or damage from mechanical abuse.

C. Manufacturer: Subject to compliance with the above provide duct sound lining in accordance with the above performance criteria description.

2.12 SOUND ATTENUATORS (SA)

A. General: Provide factory-fabricated and tested duct silencers as indicated, select with performance characteristics which match, or exceed those indicated on schedule.

B. Casings: Construct of sheet metal, with gauge and seam construction equal or greater than that recommended by SMACNA-Duct Construction Standards for ductwork of same size and pressure class; but not less than 18-gauge for outer casing and 22-gauge for inner casing.

C. Acoustic Fill: Provide inorganic mineral or glass fiber filler material, inert, vermin and moisture proof, of sufficient density to obtain specified acoustic performance. Pack under not less than 5% compression to eliminate voids due to vibration and settling. Provide hospital grade mylar liner over acoustic media.

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D. Acoustic Performance: Provide silencer ratings that have been determined in such to reverberative room test facility. Test silencer with air flow in both directions through silencer, in accordance with ASTM E477, "Methods of Testing Duct Liner Materials and Prefabricated Silencers for Acoustical and Airflow Performance."

1. For acoustic ratings, include Dynamic Insertion Loss and Self Noise Power Levels for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with airflow of at least 2,000 FPM face velocity.

E. Aerodynamic Performance: Provide silencers with static pressure loss equal to or less than that scheduled.

F. Certification: Provide certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance. Conduct all rating tests at same facility. Open testing facility for inspection by Architect/Engineer if requested.

G. Manufacturers: Subject to compliance with requirements, provide duct silencers of one of the following:

1. Industrial Acoustics Co.
2. Aeroacoustic Corporation
3. Vibro-Acoustics
4. Price
5. Or equal

2.13 AIR OUTLETS AND INLETS

A. Ceiling Air Diffusers:

1. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Stamped face diffusers will not be acceptable.

2. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw, drop and noise criteria ratings for each size device as listed in manufacturer's current data.

3. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

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4. Types: Provide ceiling diffusers of type, capacity, throw, blow and with accessories as listed on diffuser schedule.

   a. Ceiling Diffusers shall be of the restricted multi-orificed jet induction and air mixing type consisting of louver sections with built-in diffusing vanes. The vanes shall be arranged to discharge air from adjacent louvers at an angle of 45 degrees in opposite directions to insure rapid mixing of primary and room air. Diffusing vanes shall be welded and mechanically fastened to the adjacent louver sections to make a rigid unit. The vanes shall extend to the discharge edges of the louvers. Where louver sections join the core frame, the louver ends shall be welded to the core frame. The leaving edge of each louver shall be hemmed and the louver ends shall be rounded and hemmed before welding to the core frames.

   b. Diffusers shall be fabricated of aluminum or steel-welded construction, and shall be provided with a removable core permitting easy access to the neck connection. The diffuser neck shall extend no less than 1" above the core to accommodate an internal duct connection to prevent leakage into the ceiling space.

   c. Finish shall be baked enamel. Color as selected by A/E.

   d. Diffusers shall be steel of the fixed louvered face type with a minimum of four vaned assemblies. The louvered face shall be removable. The diffuser neck shall be sized to fit outside of the duct. Access to damper adjustment shall be provided through the face of the diffuser.

   e. Diffusers shall be finished with a baked enamel color as selected by A/E.

5. Diffuser Dampers:

   a. Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of diffuser. Provide in each ceiling diffuser.

6. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

   a. Tuttle & Bailey Agitair Series “RC”

   b. Metalaire – “5000 IV”

   c. Nailor

   d. Price Industries

   e. Or equal

B. Wall Registers And Grilles:

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1. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicted, and as required for complete installation.
2. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
3. Compatibility: Provide registers and grilles with border styles that are compatible with adjacent systems, and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of construction which will contain each type of register and grille.
4. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule:
5. Pattern: Register and grille patterns shall have style as identified on Drawings:
6. Dampers: Opposed Blade adjustable assembly, key operated from face of register.
7. Accessories:
    a. Plaster Frame: Perimeter frame designed to act as plaster stop and register or grille anchor. Provide where required.
    b. Operating Keys: Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustment.
8. Finish: Register and Grille Finishes shall be baked enamel color as selected by the Architect.
9. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one the following:
    a. Tuttle & Bailey Agitair (Air Devices)
    b. Carnes Co.
    c. Titus Products Div.; Philips Industries, Inc.
    d. Price Industries
    e. Or equal

C. Ceiling Registers and Grilles:

1. General: Except as otherwise indicated, provide manufacturer's standard "Egg-Crate" type registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

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2. Compatibility: Provide registers and ceiling grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling construction.

3. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule.

4. Register and Grille Materials:

   a. Aluminum Construction: Manufacturer's standard extruded aluminum frame and core.

5. Register and Grille Faces:

   a. 1/2" x 1/2" "Egg-Crate" with 1" border frame.

6. Register and Grille Dampers:

   a. Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of register (provide for registers only).

7. Register and Grille Finishes shall be baked enamel color as selected by the Architect.

8. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

   a. Tuttle & Bailey Agitair (Air Devices)

   b. Carnes Co.

   c. Titus Products Div.; Philips Industries, Inc.

   d. Price Industries

   e. Or equal

D. Security Grilles

1. Furnish and install risk resistant perforated steel maximum security (supply/return) grilles of the sizes and mounting types indicated on the plans and outlet schedule. Grilles shall be 3/16 in. hot rolled steel faceplate with 1/8 in. perforated staggered holes with 40% free area. The grille is to be attached to a wall sleeve of 3/16 in. hot rolled steel with a rear mounting frame for a concealed and secure fastening. The grille shall be painted with a powder coat process and be finished in white. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714.

2. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

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a. Price Industries

b. Kees

c. Titus Products Div.; Philips Industries, Inc.

d. Or equal

2.14 VARIABLE AIR VOLUME BOX (VAV)

A. General: Provide factory-fabricated and tested air terminals as shown on drawings, selected with performance characteristics which match or exceed those indicated on schedule.

B. Casings: Construct of die-cast aluminum or sheet metal of the following minimum thicknesses:

	Steel	Aluminum
1. Upstream Pressure Side:	22-ga.	0.032 in.
2. Downstream Pressure Side;	22-ga.	0.025 in.

3. Provide hanger brackets for attachment of supports.

4. Linings: Line inside surfaces of casings with hospital grade lining material meeting ASTM Standard C1071 to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of 1 in.. Secure lining to prevent delamination, sagging or settling. Seal edges of lining to prevent fraying.

   a. Cover liner surfaces and edges with mylar, foil or perforated metal.

5. Leakage: Construct casings such that when subjected to 0.5-in w.g. pressure for low pressure units, and 3.0-in w.g. pressure for high pressure units, total leakage does not exceed 4 percent of specified air flow capacity with outlets sealed and inlets wide open. Construct air dampers such that when subjected to 6.0-in w.g. inlet pressure with damper closed, total leakage does not exceed 10 percent of specified air flow capacity.

C. Air Dampers: Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing. Provide maximum volume dampers, pressure independent that are calibrated in cfm, factory-adjusted, and marked for specified air capacities. Provide mechanism to vary air volume thru damper from minimum to maximum, in response to signal from thermostat.

D. Controls: Provide controls accurate to 1.5 deg. F(0.8 deg. C) and adjustable from 65 deg. F (22 deg. C) to 85 deg. F (29 deg. C).

1. ATC Contractor to provide and field install DDC controls, compatible with automatic temperature control system specified in other Division-23 sections. All testing and commissioning shall be completed in field.

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E. Identification: Provide label on each unit indicating Unit Number, cfm range, cfm factory-setting, and calibration curve (if required).

F. Coils: Provide the following coils as indicated on Drawings and schedule:

1. Hot Water Heating Coils: Provide heating coils constructed of copper tubes and aluminum fins with galvanized steel casing.

G. Silencer:

1. Silencer section shall consist of 22ga solid metal casing, 22ga perforated liners, and absorptive acoustic fiberglass liner with hospital grade mylar covering or closed cell mold-block type liner.

2. Acceptable methods of silencer construction shall be button lock, Pittsburgh lock, and welds. In situations where these methods are not feasible, rivets can be used. Screws or other mechanical fasteners on the silencer will not be acceptable.

3. The silencer noses and perforated liners shall be rigidly fastened to the casing of the silencer on both the top and bottom.

4. The silencer section acoustic media shall be shot free inorganic glass fiber with long, resilient fibers, bonded with thermosetting resin, and contain 50 percent recycled media. Glass fiber shall be packed with a minimum 10 percent compression to eliminate voids and settling; density shall consistent with that used to generate catalog test data. Combustion ratings for acoustical media shall be equal to or less than the combustion ratings noted below when tested in accordance with ASTM E84, UL713, and NFPA 255:

a. Flame Spread Classification: 25

b. Smoke Development Rating: 50

5. Silencer shall be Price model SUDQ.

H. Manufacturer: Subject to compliance with requirements, provide variable air volume boxes of one of the following:

1. Price

2. Carnes Co.

3. Titus Products Div.

4. Or equal

2.15 ACCESS DOORS

A. Furnish Access Doors for access to all concealed control valves, motor operated dampers, fire doors, and to all other concealed parts of the HVAC System that require accessibility for the proper operation and maintenance of the system.

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These doors shall be installed under the appropriate SECTION of the Specifications as determined by the surface upon which the panels are mounted.

B. All Access Doors shall be located in a workmanlike manner in closets, storage rooms, and/or other non-public areas, positioned so that the valve or part can be easily reached, and the size shall be sufficient for this purpose (minimum size 12" x 16"). Furnish Access Doors for each pipe space to permit thorough inspection of same. When access doors are required in corridors, lobbies, or other habitable areas, they shall be located as directed by the Architect.

C. Access doors shall be prime painted and completed with cylinder lock and two (2) keys as manufactured by Acudor, Inland Steel Products Company "Milcor", or Walsh-Hannon-Gladwin, Inc., "Way Loctor". Type shall be as follows:

1. Acoustical Tile Ceiling — Acudor AT-5020
2. G.W.B. Surfaces — Acudor DW-5040
3. Masonry Construction — Acudor UF-5000
4. Fire Rated Construction — Acudor FB-5060

D. Access Door Shop Drawings shall be submitted to the Architect for approval.

2.16 FIRESTOPPING AND SEALANTS

A. General

1. All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed. For applications where combustible penetrants are involved, i.e. insulated and plastic pipe, a suitable intumescent material must be used.
2. This section specifically addresses pipe, duct, cable, and wiring penetrations of fire wall firestops and smoke stops for all bearing and non-bearing walls and floors assemblies.

B. References

1. American Society For Testing and Materials Standards (ASTM):
   a. ASTM E 814: Standard Test method For Fire Tests of Through-Penetration Firestops
   b. ASTM E84: Standard Test Method For Surface Burning Characteristics of Building Materials
2. Underwriters Laboratories Inc.:
3. UL 1479 Fire Tests of Through-Penetration Firestops

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1) UL 723 Surface Burning Characteristics of Building Materials

b. UL Fire Resistance Directory:

1) Through Penetration Firestop Device (XHJI)

2) Fire Resistive Ratings (BXUV)

3) Through Penetration Firestop Systems (XHEZ)

4) Fill, Void, or Cavity Material (XHHW)

C. Definitions

1. Firestopping: The use of a material or combination of materials in a fire-rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating on that wall or floor.

2. System: The use of a specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), constitutes a "System".

3. Barrier: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.

4. Through-Penetration: Any penetration of a fire-rated wall or floor that completely breaches the barrier.

5. Membrane-Penetration: Any penetration in a fire-rated wall that breaches only one side of the barrier.

6. Construction Gaps: Any gap, joint, or opening, whether static or dynamic, where the top of a wall may met a floor; wall to wall applications, edge to edge floor configurations; floor to exterior wall; or any linear breach in a rated barrier. Where movement is required, the firestopping system must comply with UL2079 for dynamic joints.

D. Quality Assurance

1. Firestopping systems (materials and design):

a. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.

b. The F rating must be a minimum of one (10 hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). the fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.

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c. For joints, must be tested to UL2079 with movement capabilities equal to those of the anticipated conditions.

2. Firestopping materials and systems must be capable of closing or filling through openings created by 1) the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or 2) deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).

3. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.

4. Firestopping sealants must be flexible, allowing for normal pipe movement.

5. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.

6. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

7. All firestopping materials shall be manufactured by one manufacturer (to the maximum extent possible).

8. Installation of firestopping systems shall be performed by a contractor (or contractors) trained or approved by the firestop manufacturer.

9. Material used shall be in accordance with the manufacturer's written installation instructions.

E. Materials

1. Intumescent Firestop Sealants and Caulks:

   a. STI SpecSeal S100 and S500 Sealant

   b. 3M Fire Barrier Caulk CP25WB+

2. Latex Firestop Sealant:

   a. STI SpecSeal LC150 Sealant

3. Silicone Firestop Sealants and Caulks:

   a. STI SpecSeal Pensil 100 and 300

   b. 3M Fire Barrier Silicone Sealants

4. Firestop Putty:

   a. STI SpecSeal Firestop Putty Bars and Pads

   b. 3M Fire Barrier Moldable Putty

5. Firestop Collars:

   a. STI SpecSeal Firestop Collars

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b. 3M Fire Barrier PPD's

6. Wrap Strips:
   a. SpecSeal Wrap Strip
   b. 3M Fire Barrier FS195 Wrap Strip
7. 2-Part Silicone Firestop Foam:
   a. STI SpecSeal Pensil 200
   b. 3M Fire Barrier 2001 Silicone Foam
8. Firestop Mortar:
   a. STI SpecSeal Mortar
9. Composite Board:
   a. 3M Barrier Sheet Material
10. Accessories:
   a. Forming/Damming Materials: Mineral Fiberboard or other type as per manufacturer recommendation.

2.17 AUTOMATIC TEMPERATURE CONTROLS (DDC) (Refer to section 01 81 00 Commissioning for additional contract requirements)

A. Basic Components and Systems:

1. General: Provide control products in sizes and capacities indicated, consisting of dampers, thermostats, clocks, sensors, controllers, and other components as required for completed installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information, designed and constructed as recommended by manufacturer and as required for application indicated. All equipment and systems shall be installed by factory trained contractors with the following functional and construction features.
2. The ATC controls system shall be connected to the existing building control system and shall be of the same existing buildings ATC control system which is manufactured by Tridium Niagara. ATC Contractor shall provide a new Jace controller for the library and connect it to the existing network, as well as, create new system/equipment graphics on existing control platform workstation which shall include all new/existing equipment, sensors, alarms, scheduling & provide programming as required for the new and renovated areas. Refer to control drawings for further requirements.
3. ATC Contractor Qualifications
   a. The ATC contractor shall be fully licensed at the time of bid to do business in the job site area. Wholesalers, dealers, or any firm whose

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principal business is not that of installing DDC controls will not be acceptable.

b. All project engineering, coordination, procurement, testing, installation, startup, and pre-commissioning need to be performed by regular employees of the ATC contractor.

c. The control system shall be installed by competent technicians, electricians and fitters who are regular employees of the ATC contractor.

4. Electric Wiring: All electric wiring and wiring connections, either line voltage or low voltage, from electric panels to the ATC panels, and from the ATC related panels to the individual control devices i.e. rooftop units, exhaust fans, VAV and dampers required for the installation of the control system, as herein specified shall be provided by the control contractor unless specifically shown on the electrical drawings or called for in the electrical specifications.

a. The wiring installation shall be in accordance with National and Local Codes and with the Electrical portion of these specifications. All wiring shall be run concealed wherever possible. Exposed wiring in occupied areas shall be run in raceways. Raceways shall be Wiremold 200 series with all elbows, raceways, covers, mounting stops, box extensions and wiring for a complete and neat installation. All wiring located in mechanical spaces, boiler rooms, and fan rooms shall be installed in metal conduit

b. All wiring above ceilings, in boiler rooms, and all mechanical spaces shall follow routing of piping and where not possible shall be in conduit. All exposed wire shall be bundled and wire tied and shall be supported to adjacent piping. Draped and free floating wire will not be allowed.

c. All terminations of wire at control devices shall be looped and supported adequately.

d. All wiring shall comply with the requirements of the electrical section of the specification.

B. Controls Systems Wiring

1. All conduit raceways, wiring, accessories and wiring connections required for the installation of the Controls Systems shall be provided by the Controls Contractor except as shown on the Electrical Trade documents. All wiring shall comply with the requirements of applicable portions of the Electrical Trade work and all local and national electric codes and the requirements of the AHJ.

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2. All Controls Systems wiring materials and installation methods shall comply with the original equipment manufacturer recommendations and standards.

3. The sizing type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the Controls Contractor.

4. Class 2 Wiring

   a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.

   b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5ft. from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines.

5. Class 2 signal wiring and 24VAC power may be run in the same conduit. Power wiring 120VAC and greater shall not share the same conduit with Class 2 signal wiring.

6. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:

   a. All circuits are continuous and free from short circuits and grounds.

   b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms.

   c. All circuits are free from induced voltages.

7. Provide complete testing for all cables and wiring. Provide all equipment, tools, and personnel as necessary to conduct these tests.

8. Provide for complete grounding of all signal and communication cables, panels and equipment so as to ensure integrity of Controls Systems operation. Ground cabling and conduit at panel terminations. Do not create ground loops.

9. All ATC control wiring for life-safety system shall be 2-hour rated and installed in metal conduits.

10. Provide all required control wiring including CAT6 Ethernet wiring for any controllers requiring Ethernet connectivity. Terminate Ethernet cable in MDF and IDF closets on patch panels, provide as necessary.

C. Line Voltage Power Sources

1. 120-volt AC circuits for the Controls Systems shall be taken by the Controls Contractor from electrical trade panelboards and circuit breakers as designated on the electrical drawings.

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2. Circuits used for the Controls Systems shall be dedicated to these Controls Systems and shall not be used for any other services.

3. Controls DDC terminal unit controllers may use 120-volt AC power from motor power circuits.

D. Controls Systems Raceways

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in the Specification. Minimum conduit size 3/4".

2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Engineer.

3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the supporting surface.

4. UL/ULC Listed Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls and for final connection to equipment.

E. Penetrations

1. Firestopping for all penetrations used by dedicated Controls Systems conduits and raceways shall be by other trades.

2. All openings in fire proofed or fire stopped components shall be closed by other trades using approved fire resistive sealant.

3. All wiring passing through penetrations, including walls, shall be in sleeves, conduit or enclosed raceway.

4. No penetrations through building structural elements, slabs, ceilings and walls shall be made before receipt of written approval from the Engineer.

F. Controls Systems Identification Standards

1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node environmental location.

2. Cable shall be labeled at every termination with cross-referencing to record documentation.

3. Raceway Identification: Exposed covers to junction and pull boxes of the FMS raceways shall be identified at primary points.

4. Wire Identification: All low and line voltage wiring shall be identified by a number, as referenced to the associated shop and record drawing, at each termination.

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5. Wires and cabling shall not be spliced between terminations. Cable shields shall be single end grounded – typically at the panel end outside the panel.

6. Suggested color coding, for use at the Contractors option, are:

Analog Input Cable	Yellow
Analog Output Cable	Tan
Binary Input Cable	Orange
Binary Output Cable	Violet
24 VAC Cable	Gray
General Purpose Cable	Natural
Tier 1 Comm Cable	Purple
Other Tier Comm Cable	Blue

7. Provide permanent identification labels at all valve and damper actuators to indicate open and closed positions.

G. Field Panel And Device Installations And Locations

1. The Controls Systems panels, enclosures and cabinets shall be located as coordinated with the Engineer 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. All field devices shall be installed per the manufacturer recommendation and in accessible locations as coordinated with the Engineer.

3. Panels to be located in damp areas or areas subject to condensation shall be mounted with wall standoffs.

4. Conduit configurations entering or leaving panels and devices shall be such as to preclude condensation traps.

H. DDC & HVAC MECHANICAL EQUIPMENT CONTROLLERS <TEC>

1. The DDC & HVAC Mechanical Equipment Controllers shall reside on the Building Level Network.

   a. DDC & HVAC Mechanical Equipment Controllers shall use the same programming language and tools. DDC & HVAC Mechanical Equipment Controllers which require different programming language or tools on a network are not acceptable.

   b. DDC & HVAC Mechanical Equipment Controllers which do not meet the functions specified in here within for HVAC Mechanical Equipment Controllers are not acceptable.

I. DDC CONTROLLER

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1. DDC Controllers shall be a Bacnet MS/TP protocol, include 256 MB RAM / 128 MB Flash, 2 10/100 Mbps Ethernet Ports, I non-isolated RS-485 port, 1 RS-232 port, 1 NDIO port, 2 communication card option slots, embedded software, web user interface, data recovery services with SRAM Niagra driver, oBIX driver, N2 driver and Bacnet MS/TP driver. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point I/O schedule. Each controller shall support a minimum of three (3) Floor Level Application Specific Controller Device Networks.
2. Each DDC Controller shall have 256 Megabytes of memory to support its own operating system and databases, including:
    a. Control processes
    b. Energy management applications
    c. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
    d. Historical/trend data for points specified
    e. Maintenance support applications
    f. Custom processes
    g. Operator I/O
    h. Dial-up communications
    i. Manual override monitoring
3. Each DDC Controller shall support firmware upgrades without the need to replace hardware.
4. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
5. DDC Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.
6. As indicated in the point I/O schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
    a. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.

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b. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

7. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.

8. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

9. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:

   a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V

   b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact

   c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power

   d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)

   e. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:

      1) IEEE Standard 587-1980

      2) UL 864 Supply Line Transients

      3) Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)

10. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.

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a. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

b. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

11. Provide a separate DDC Controller for each component. It is intended that each unique system be provided with its own point resident DDC Controller.

J. HVAC MECHANICAL EQUIPMENT CONTROLLERS

1. HVAC Mechanical Equipment Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.

2. Each HVAC Mechanical Controller shall have 72 Megabytes of memory to support its own operating system and databases, including:

Control processes

a. Energy management applications

b. Alarm management applications including custom alarm messages for each level alarm for each point in the system.

1) Historical/trend data for points specified

2) Maintenance support applications

3) Custom processes

4) Operator I/O

5) Remote communications

3. HVAC Mechanical Equipment Controllers shall provide a RS-232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals.

4. HVAC Mechanical Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

5. Each HVAC Mechanical Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Mechanical Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

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6. In the event of the loss of normal power, there shall be an orderly shutdown of all HVAC Mechanical Equipment Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

   a. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.

   b. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

K. DC & HVAC MECHANICAL EQUIPMENT CONTROLLER RESIDENT SOFTWARE FEATURES

1. General:

   a. The software programs specified in this Section shall be provided as an integral part of DDC and HVAC Mechanical Equipment Controllers and shall not be dependent upon any higher level computer for execution.

   b. All points shall be identified by up to 30 character point name and 16 character point descriptor. The same names shall be used at the PC workstation.

   c. All digital points shall have user defined two-state status indication (descriptors with minimum of 8 characters allowed per state (i.e. summer/winter)).

2. Control Software Description:

   a. The DDC and HVAC Mechanical Equipment Controllers shall have the ability to perform the following pre-tested control algorithms:

      1) Two-position control

      2) Proportional control

      3) Proportional plus integral control

      4) Proportional, integral, plus derivative control

      5) Automatic tuning of control loops

3. DDC and HVAC Mechanical Equipment Controllers shall provide the following energy management routines for the purpose of optimizing energy consumption while maintaining occupant comfort.

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a. Start-Stop Time Optimization (SSTO) shall automatically be coordinated with event scheduling. The SSTO program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by time of occupancy. The SSTO program shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions.

1) The SSTO program shall operate in both the heating and cooling seasons.

a) It shall be possible to apply the SSTO program to individual fan systems.

b) The SSTO program shall operate on both outside weather conditions as well as inside zone conditions and empirical factors.

2) The SSTO program shall meet the local code requirements for minimum outside air while the building is occupied.

a. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or groups of points according to a stored time.

1) It shall be possible to individually command a point or group of points.

2) For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start or stop within that group.

3) The operator shall be able to define the following information:

a) Time, day

b) Commands such as on, off, auto, and so forth.

c) Time delays between successive commands.

d) There shall be provisions for manual overriding of each schedule by an appropriate operator.

4) It shall be possible to schedule events up to one year in advance.

a) Scheduling shall be calendar based.

b) Holidays shall allow for different schedules.

c) Enthalpy switchover (economizer) .The Energy Management Control Software (EMCS) will control

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the position of the air handler relief, return, and outside air dampers. If the outside air dry bulb temperature falls below changeover set point the EMCS will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.

d) Temperature-compensated duty cycling.

e) The DCCP (Duty Cycle Control Program) shall periodically stop and start loads according to various patterns.

f) The loads shall be cycled such that there is a net reduction in both the electrical demands and the energy consumed.

g) Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.

h) Night setback control: The system shall provide the ability to automatically adjust setpoints for night control.

i) The Peak Demand Limiting (PDL) program shall limit the consumption of electricity to prevent electrical peak demand charges.

j) PDL shall continuously track the amount of electricity being consumed, by monitoring one or more electrical kilowatt-hour/demand meters. These meters may measure the electrical consumption (kWh), electrical demand (kW), or both.

k) PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.

l) If the PDL forecasted demand indicates that electricity usage is likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads.

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m) Once the demand peak has passed, loads that have been shed shall be restored and returned to normal control.

4. DDC and HVAC Mechanical Equipment Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

   a. A single process shall be able to incorporate measured or calculated data from any and all other DDC and HVAC Mechanical Equipment Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC and HVAC Mechanical Equipment Controllers on the network. Database shall support 30 character, English language point names, structured for searching and logs.

   b. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.

   c. DDC and HVAC Mechanical Equipment Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task orientated information from the user manual.

   d. DDC and HVAC Mechanical Equipment Controller shall be capable of comment lines for sequence of operation explanation.

5. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC and HVAC Mechanical Equipment Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC and HVAC Mechanical Equipment Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

   a. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.

   b. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms.

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Each DDC and HVAC Mechanical Equipment Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.

c. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs based on time (after hours destinations) or based on priority.

d. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.

e. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.

6. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.

a. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC and HVAC Mechanical Equipment Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of l minute to 7 days shall be provided. Each DDC and HVAC Mechanical Equipment Controller shall have a dedicated RAM-based buffer for trend data and shall be capable of storing a sufficient number of data samples. All trend data shall be available for transfer to a Workstation without manual intervention.

b. DDC and HVAC Mechanical Equipment Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary.

1) Loop tuning shall be capable of being initiated either locally at the DDC and HVAC Mechanical Equipment Controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

7. DDC and HVAC Mechanical Equipment Controllers shall be capable of automatically accumulating and storing run-time hours for digital input

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and output points and automatically sample, calculate and store consumption totals for analog and digital pulse input type points, as specified in the point I/O schedule.

8. The peer to peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to access any data from or send control commands and alarm reports directly to any other DDC and HVAC Mechanical Equipment Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC and HVAC Mechanical Equipment Controllers shall send alarm reports to multiple workstations without dependence upon a central or intermediate processing device. The peer to peer network shall also allow any DDC and HVAC Mechanical Equipment Controller to access, edit, modify, add, delete, back up, and restore all system point database and all programs.

9. The peer to peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control the points that the operator is authorized for. All other points shall not be displayed on the PC workstation or portable terminal (e.g. all base building and all tenant points shall be accessible to any base building operators, but only tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.

L. Field Devices

1. Provide instrumentation as required for monitoring, control or optimization functions.

2. Room Temperature Sensors

a. All areas/spaces including but not limited to classrooms and small group rooms shall have combination room sensors for temperature, humidity and CO2 and shall have day / night override button, and setpoint slide adjustment option but have no display of space parameters. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment. All temperature sensors shall be BACnet compatible network type.

Temperature monitoring range	+20/120 deg. F -13 deg. to 49 deg. C)
Output signal	Changing resistance
Accuracy at Calibration point	+0.5 deg. F (+/- 0.3 deg. C)
Set Point and Display Range	55 deg. to 95 deg. F (13 deg. to 35 deg. C)

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3. Liquid immersion temperature:
   a. Temperature monitoring range +30/250 deg. F (-1 deg./121 deg. C)
   b. Output signal Changing resistance
   c. Accuracy at Calibration point +0.5 deg. F (+/-0.3 deg. C)
4. Duct (single point) temperature:
   a. Temperature monitoring range +20/120 deg. F (-7 deg. /49 deg. C)
   b. Output signal Changing resistance
   c. Accuracy at Calibration point +0.5 deg. F (+/-0.3 deg. C)
5. Duct Average temperature:
   a. Temperature monitoring range +20 deg.+120 deg.F(-7 deg./+49 deg. C)
   b. Output signal 4 – 20 mA DC
   c. Accuracy at Calibration point +0.5 deg. F (+03 deg. C)
   d. Sensor Probe Length 25 ft. L (7.3m)
6. Outside air temperature:
   a. Temperature monitoring range -58deg.+122deg.F(-50deg.Cto 50deg.C)
   b. Output signal 4 – 20 mA DC
   c. Accuracy at Calibration point +0.5 deg. F (+/-0.3 deg. C)
7. Differential pressure:
   a. Unit for fluid flow proof shall be Penn P74.
   b. Range 8 to 70 psi
   c. Differential 3 psi
   d. Maximum differential pressure 200 psi
   e. Maximum pressure 325 psi
   f. Unit for air flow settings.
   g. Set point ranges: 0.5 in. WG to 1.0 in. WG (124.4 to 248.8 Pa)
      1.0 in. WG to 12.0 in. WG (248.8 to 497.6 Pa)
8. Static pressure sensor:
   a. Range 0 to .5 in.WG (0 to 124.4 Pa)
      0 to 1 in.WG (0 to 248.8 Pa)
      0 to 2 in. WG (0 to 497.7 Pa)

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0 to 5" in.WG (0 to 1.2 kPa)

0 to 10" WG (0 to 2.5 kPa)

b. Output Signal 4 – 20 mA VDC

c. Combined static error 0.5 percent full range

d. Operating Temperature -40 deg. to 175 deg. F (-40 deg. C to 79.5 deg. C)

9. Air Pressure Sensor:

a. Range: 0 to 0.1 in. water (0 to 24.9 Pa)

0 to 0.25 in. water (0 to 63.2 Pa)

0 to 0.5 in. water (0 to 124.5 Pa)

0 to 1.0 in. water (o to 249 Pa)

0 to 2.0 in water 90 to 498 Pa)

0 to 5.0 in. water (0 to 1.25 kPa)

0 to 10.0 in. water (0 to 2.49 kPa)

b. Output signal 4 to 20 mA

c. Accuracy +1.0 percent of full scale

10. Humidity Sensors: All room/zone humidity sensors shall be BACnet compatible network type.

a. Range 0 to 100 percent RH

b. Sensing Element Bulk Polymer

c. Output Signal 4 – 20 mA DC

d. Accuracy At 77 deg. F (25 deg. C) + 2 percent RH

11. Humidistat:

a. Range 0 to 100 percent RH

b. Sensing Element Bulk Polymer

c. Output Signal 4 – 20 mA DC

d. Accuracy At 77 deg. F(25 deg. C) + 2 percent RH

12. Pressure to Current Transducer

a. Range 3 to 15 psig (21 to 103 kPa) or 3 to 30 psig (21 to 207 kPa)

b. Output signal 4 – 20 mA

c. Accuracy + 1 percent of full scale (+ 0.3 psig)

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13. Carbon Dioxide Sensor : All room/zone CO2 & duct mounted sensors shall be BACnet compatible network type and shall have a minimum 5 year calibration period.

    a. Range 0 to 1500 ppm

    b. Accuracy 20+ ppm

14. Damper Actuators

    a. Electric control shall be direct coupled actuators with position feedback to BMS.

    b. Damper actuators shall be Brushless DC Motor Technology with stall protection, bi-directional, fail safe spring return, all metal housing, manual override, independently adjustable dual auxiliary switch.

        1) The actuator assembly shall include the necessary hardware and proper mounting and connection to a standard ½ in. diameter shaft or damper blade.

    c. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.

    d. All actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator's output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed "v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with the damper shaft.

    e. All actuators having more than a 100 lb-in torque output shall accept a 1 in. diameter shaft directly, without the need for auxiliary adapters.

    f. All actuators shall be designed and manufactured by Belimo or approved equal using ISO900 registered procedures, and shall be Listed under Standards UL873 and CSA22.2 No. 24-93 l.

M. MISCELLANEOUS DEVICES

1. Current Sensing Relay:

    a. Provide solid-state, adjustable, current operated relay. Provide a relay which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.

    b. Adjust the relay switch point so that the relay responds to motor operation under load as an "on" state and so that the relay responds to an unloaded running motor as an "off" state. A motor with a broken belt is considered an unloaded motor.

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c. Provide for status device for all fans.

2. Electronic Airflow Measurement Stations and Transmitters (Where indicated on Control Drawings).

   a. Provide air flow monitoring stations as shown on drawings.

3. Duct and Plenum Mounted Air Flow Measuring Stations.

   a. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube. Sensor probe mounting brackets shall be constructed of 304 stainless steel.

   b. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housing constructed of glass-filled polypropylene.

   c. Sensor nodes shall operate from -20 to 160 degrees Fahrenheit. Sensor nodes shall be capable of reading velocity on a scale of 0-5,000 fpm with an accuracy of +/- 2% of actual reading.

   d. A remotely located microprocessor-based transmitter shall be provided for each measurement location, local readout shall be provided on unit. The transmitter shall be provided with two field selectable analog outputs (0-10 VDC or 4-20 mA) as well as an isolated RS-485 BACnet network connection.

   e. Provide Ebtron GTx116-P+ or Paragon FE-1000.

4. Fan Inlet Style Air Flow Measuring Stations

   a. Provide fan inlet and outdoor airflow measuring devices for air handling units as shown on drawings. Each airflow measuring device shall consist of multiple measuring probes.

   b. Fan inlet probes shall not be mounted in the smallest diameter of the inlet of the fan, the probes shall not have a negative effect on the performance of the fan or the noise generated by the fan. In instances where access to the air handling units' fans is restricted utilize duct mounted airflow measuring probes. A remotely located microprocessor-based transmitter shall be provided for each measurement location, local readout shall be provided on unit. The transmitter shall be provided with two field selectable analog outputs (0-10 VDC or 4-20 mA) as well as an isolated RS-485 BACnet network connection.

   c. ATC contractor shall consult factory trained manufacturer's representative as part of this contract to assist in design and to inspect all outside air measurement installations and assist in calibrating and adjusting the air flow measuring stations as

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required to meet final balancing setting to provide accurate BMS monitoring and control.

d. Provide Ebtron GTx108-F or Paragon Model FE-1050.

5. Manufacturers: Subject to compliance with requirements, provide automatic temperature controls as manufactured and installed by:

a. Tridium Niagara

b. Or equal

PART 3 EXECUTION

3.00 INSTALLATION OF VALVES

A. Examine valve interior through the end ports, for cleanliness, freedom from foreign matter and corrosion. Remove special packing materials, such as blocks used which prevents disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the position in which it was shipped.

C. Examine threads on both the valve and the mating pipe for form (out-of-round or local indentation) and cleanliness.

D. Examine mating flange faces for conditions which might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size and material, and for freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

F. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

1. Copper Tube 2" and smaller (Heating Hot Water and Low Pressure Steam): Solder ends.

2. Steel Pipe Sizes 2" and smaller: Threaded or grooved-end.

3. Steel Pipes Sizes 2-1/2" and larger: Grooved-end or welded.

G. Valve Installation:

1. Locate valves for easy access and provide separate support where necessary.

2. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.

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3. Install valves in horizontal piping with the stem at or above the center of the pipe.

4. Installation of Check Valves: Install for proper direction of flow as follows:

   a. Swing Check Valves: Install in horizontal position with hinge pin level.

   b. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position.

   c. Lift Check Valves: Install in piping line with stem upright and plumb.

H. Threaded Connections:

1. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

2. Align threads at point of assembly.

3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

I. Flanged Connections:

1. Align flanges surfaces parallel.

2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using a torque wrench.

J. Grooved Connections:

1. Installation shall be in accordance with the latest published instructions from the manufacturer.

K. Field Quality Control:

1. Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

L. Adjusting and Cleaning:

1. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive painting or insulation.

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3.01 INSTALLATION OF METERS AND GAUGES

A. Installation of Temperature Gauges:

1. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor.

2. Temperature Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure Cap.

B. Installation of Pressure Gauges:

1. General: Install pressure gauges in piping tee with pressure gauge located on pipe at most readable position.

2. Pressure Gauge Cocks: Install in piping tee with snubber. Install siphon for steam pressure gauges.

C. Installation of Flow Measuring Fittings:

1. General: Install flow measure fittings in piping systems located in accessible locations.

D. Adjusting and Cleaning:

1. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

2. Cleaning: Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

3.02 INSTALLATION OF HANGERS & ATTACHMENTS

A. Vibration Control and Seismic Restraint: Refer to section 23 05 48 and drawing VS1.01 and VS1.02 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 23 05 48 and drawing VS1.01 and VS1.02.

B. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

C. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors, and other building structural attachments.

D. Prior to installation of hangers, supports, anchors, and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and

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Architect/Engineer for purposes of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

E. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through the openings at the tops of inserts.

F. Install hangers, supports, clamps, and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

2. Prevent electrolysis in support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.

3. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

4. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

5. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

6. Insulated Piping: Comply with the following installation requirements:

   a. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

   b. Shields: For pipe sizes up to and including 4” provide heavy gauge shield at each hanger point.

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c. Saddles: For all pipe sizes over 4" provide saddle at each hanger point. Completely fill void in saddle with loose insulation.

G. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer for loading and stresses to connected equipment.

H. Fabricate and install anchor by welding steel shapes, plates, and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

I. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

J. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

K. Provide concrete housekeeping bases for all floor-mounted equipment. Size bases to extend minimum of 4" beyond equipment base in any direction; and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

L. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

M. Adjusting and Cleaning:

1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

3. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.03 INSTALLATION OF MECHANICAL IDENTIFICATION

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow:

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1. Plastic pipe markers, with application system as indicated. Install on pipe insulation segment where required for hot non-insulated pipes.

C. Locate pipe markers and color bands as follows wherever piping is in or above occupied spaces or corridors, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings.

D. Valve Identification:

1. General: Provide valve tag on every valve, cock, and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
2. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

E. Mechanical Equipment Identification:

1. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device.
2. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2' - 0", 1\2" high for distances up to 6' - 0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

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F. Adjusting and Cleaning:

1. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

2. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.04 INSTALLATION OF MECHANICAL INSULATION

A. Installation of Piping Insulation:

1. Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; on heating piping beyond control valve, located within heated space; on condensate piping between steam trap and union; and on unions, flanges, strainers, flexible connections, and expansion joints. (Couplings in mechanical grooved systems will be insulated.)

2. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

3. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance tests.

4. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

5. Clean and dry pipe surfaces prior to insulating. Butt installation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

6. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

7. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

8. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

9. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

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B. Installation of Ductwork Insulation:

1. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its indented purpose.
2. Install insulation materials with smooth and even surfaces.
3. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
4. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
5. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
6. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

C. Protection and Replacement:

1. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
2. Protection; Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.05 INSTALLATION OF HYDRONIC PIPING AND ACCESSORIES

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS.1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS.1.

3.06 INSTALLATION OF ROOFTOP UNITS W/ ENERGY RECOVERY

A. Vibration Control and Seismic Restraint: Refer to section 23 05 48 and drawing VS.1 and VS.1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 23 05 48 and drawing VS.1.

B. General: Install rooftop energy recovery units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

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C. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air-handling units with other work.

D. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

F. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

G. Duct Connections: Provide ductwork, accessories, and flexible connections as indicated.

H. Grounding: Provide positive equipment ground for air-handling unit components.

I. Testing: Upon completion of installation of energy recover units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, than retest to demonstrate compliance.

J. Startup Services

1. Manufacturer’s Supervision: A factory-trained service representative of the manufacturer will supervise the unit startup and application specific calibration of control components.

a. The single packaged unit will not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated, and fan has been test run under observation.

b. After the single packaged unit is installed, the variable speed drive will be field commissioned by a factory trained and employed service technician.

K. Provide two complete extra sets of filters for each air handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

L. Provide one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

3.07 INSTALLATION OF TERMINAL HEATING UNITS (HYDRONIC)

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS.1 for the appropriate support of each piece of HVAC equipment noted as

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requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS.1.

B. Installation of Finned Tube Radiation: (Hydronic)

1. General: Install finned tube radiation as indicated, and in accordance with manufacturer's installation instructions.

2. Locate finned tube radiation as indicated, run cover wall-to-wall unless otherwise indicated. Provide butt caps, splice joints, "Z" bends etc. for a complete installation.

3. Install access panels centered in front of each shutoff valve, balancing cock, steam trap, or temperature control valve.

C. Connections

1. Piping installation requirements are specified in other Division 23 Sections. Drawings indicated general arrangement of piping, fittings, and specialties.

2. Install piping adjacent to radiant panels to allow for service and maintenance.

3. In addition to Division 23 Section “Hydronic Piping”, connect copper tubing to supply with shut-off valve, strainer, control valve, and union or flange, and return pipe with balancing valve and union or flange.

D. Field Quality Control

1. Perform the following field tests and inspections and prepare test reports:

a. Leak Test: After installation, fill water tubes and test for leaks. Repair leaks and retest until no leaks exist.

b. Operational Test: After electrical circuitry has been energized, start units to conform to proper unit operation.

c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field assembled components and equipment installation, including connections, and to assist in field testing. Report any findings in writing.

3. Remove and replace malfunctioning units and retest as specified above.

E. Cleaning and Protection

1. Clean all visible surfaces of equipment; touch up as required.

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2. Protect all units before, during and after installation. Damaged materials due to improper protection shall be cause for rejection.

F. Construction Phase Services

1. Manufacturer or factory-authorized representative shall visit the site regularly during the installation process to ensure proper means and methods are being employed. Bid shall include the cost of a minimum of two (2) such visits.

2. Manufacturer or factory-authorized representative shall provide start-up and training services to owners/staff to adjust, operate, and maintain radiant panels.

G. Adjusting and Cleaning:

1. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

2. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

3. Install new filter units for terminals requiring same.

3.08 INSTALLATION OF METAL DUCTWORK

A. Vibration Control and Seismic Restraint: Refer to section 230548 and drawing VS.1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS.1.

B. Installation of Metal Ductwork:

1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately with internal surface smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

2. Sealing: All ductwork joints and seams shall be sealed with flexible duct sealer to assure an airtight installation.

3. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

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a. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate.

4. Coordination: Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

5. Installation: Install metal ductwork in accordance with "SMACNA HVAC Duct Construction Standards".

C. Installation of Duct Liners:

1. General: Install duct liners in accordance with SMACNA "HVAC Duct Construction Standards".

D. Installation of Flexible Ducts:

1. Maximum Length: For any duct run using flexible ductwork, do not exceed 4'-0" extended length.

2. Installation: Install in accordance with Section II of SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible".

E. Installation of Kitchen Exhaust Ducts:

1. General: Fabricate joints and seams with continuous welds for watertight construction. Provide for thermal expansion of ductwork through 2000 degrees F (1093 degrees C) temperature range. Install without dips or traps which may collect residues. Provide access openings at each change in direction, locate on sides of duct 1-1/2" minimum from bottom, and fitted with grease-tight covers of same material as duct.

2. Kitchen exhaust hood ductwork shall be fabricated and installed in full accordance with the requirements of NFPA Bulletin 96. Duct work shall be fabricated of 16 gauge minimum thickness, black steel with all joints welded. Duct shall be properly attached to exhaust hoods and fans. Required clean-out access doors shall be installed in the vertical face of the ductwork. Only opposed blade dampers may be used in kitchen make-up air duct work requiring balancing.

F. Field Quality Control:

1. Leakage Tests: After each duct system, which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA "HVAC Air Duct Leakage Test Manual". Repair leaks and repeat tests until total leakage is less than 1% of system design air flow.

G. Equipment Connections:

1. General: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery.

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H. Adjusting and Cleaning:

1. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

2. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

3. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until final connections are to be completed.

4. Balancing: Refer to Division 23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork. Seal any leaks in ductwork that become apparent in balancing process.

3.09 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 degree elbows in supply, return, and exhaust air systems, and elsewhere as indicated.

C. Install splitter damper with adjusting rod in each supply branch. Install according to detail on drawings.

D. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

E. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

F. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

G. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

H. Furnish extra fusible links to owner, one link for every 10 installed of each temperature range; obtain receipt.

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3.10 INSTALLATION OF ACOUSTIC DUCT LINING

A. Installation: All portions of duct designed to receive duct liner shall be completely covered. The smooth, black coated surfaces shall face the airstream. All liners shall be cut to assure tight, overlapped corner joints. The top pieces shall be supported by the side pieces. The liner shall be adhered to the sheet metal with full coverage of an approved adhesive that conforms to ASTM C 916, and all exposed leading edges and transverse joints shall be coated with Permacote factory-applied or field-applied edge coating and shall be neatly butted without gaps. Shop or field cuts shall be liberally coated with "Schuller SuperSeal Edge Treatment" or approved adhesive. The liner shall be additionally secured with mechanical fasteners. The pin length should be such as to hold the material firmly in place with minimum compression of the material.

3.11 INSTALLATION OF SOUND ATTENUATORS

A. VIBRATION CONTROL AND SEISMIC RESTRAINT: Refer to section 230548 and drawing VS.1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS.1.

B. General: Install sound attenuators as indicated, and in accordance with manufacturer's installation instructions.

C. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

D. Upon completion of installation test and demonstrate that sound attenuators, and duct connections to sound attenuators, are leak tight.

3.12 INSTALLATION OF AIR OUTLETS AND INLETS

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.13 INSTALLATION OF VARIABLE AIR VOLUME BOXES

A. Vibration Control And Seismic Restraint: Refer to section 230548 and drawing VS1.1 for the appropriate support of each piece of HVAC equipment noted as requiring such. The vibration control and seismic restraint manufacturer shall recommend the correct connection and device as outlined in section 230548 and drawing VS1.1.

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B. General: Install variable air volume boxes as shown on drawings, and in accordance with manufacturer's installation instructions.

C. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

3.14 INSTALLATION OF ACCESS DOORS

A. General: Install access doors in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. All access doors shall be located in a workmanlike manner in closets, storage rooms, and/or other non-public areas, positioned so that the item or part can be easily reached, and the size shall be sufficient for this purpose (minimum size 12" x 16"). Furnish access doors to permit thorough inspection. When access doors are required in corridors, lobbies, or other habitable areas, they shall be located as directed by the Architect.

3.15 INSTALLATION OF FIRESTOPPING AND SEALANTS

A. Examination

1. Examine the areas and conditions where firestops are to be installed and notify the architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the architect and in accordance with Section 07 84 13.

2. Verify that environmental conditions are safe and suitable for installation of firestop products.

3. Verify that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

B. Installation

1. General:

a. Installation of firestops shall be performed b an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.

b. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.

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c. Unless specified and approved, all in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.

d. Seal holes and penetrations to ensure an effective smoke seal.

e. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.

f. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.

g. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

2. Dam Construction: When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

C. Field Quality Control

1. Prepare and install Firestopping system in accordance with manufacturer's printed instructions and recommendations.

2. Follow safety procedures recommended in the Material Safety Data Sheets.

3. Finish surfaces of firestopping which are to remain exposed in the completed work to a uniform and level condition.

4. All areas of work must be accessible until inspection by the applicable Code Authorities.

5. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification.

6. Cleaning

7. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.

8. Leave finished work in neat, clean condition with no evidence of spill overs or damage to adjacent surfaces.

3.16 INSTALLATION OF AUTOMATIC TEMPERATURE CONTROLS (DDC)

A. Installation of Control Systems:

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1. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

2. Control Wiring: Install control wiring, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.

   a. Install circuits over 25-volt with color-coded No. 12 wire in electric metallic tubing.

   b. Install circuits under 25-volt with color-code No. 18 wire with 0.031" high temperature 105° F. (41° C) plastic insulation on each conductor and plastic sheath over all.

   c. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.

   d. Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electrical conduit.

   e. Power sources from lighting circuits and wall outlets shall not be used to power DDC controllers.

3. Controllers and safety devices:

   a. All safety devices such as freezestats, duct mounted heat detectors, smoke detectors, etc., shall be hard wired to shut down the fans independently. Provide audible alarm with silence switch as well as DDC indication.

   b. Humidifier controls shall be hard wired through fan proof flow differential switch and starter auxiliary contacts to disable humidifier system on fan shutdown. Provide DDC indication.

   c. All supply, return and exhaust fans shall be provided with pressure differential switches. Current sensing devices, starter axillary contacts, and relay contacts are unacceptable proof of fan operation.

   d. Primary and standby pumps shall be selectable through the DDC control system. Provide local pilot light to indicate selected pump as well as alarm and silence switch for failed pump. Provide differential pressure switch to prove flow.

B. Adjusting and Cleaning:

1. Start-Up: Start-up, test, and adjust pneumatic control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

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2. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3. Final Adjustment: After completion of installation, adjust thermostats, control valves, motor and similar equipment provided as work of this section.

   a. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

C. Closeout Procedures:

1. Owner's Instructions: Provide services of manufacturer's technical representative for one 8-hour day to instruct Owner's personnel in operation and maintenance of control systems, and 40 hours of onsite instruction on running and basic troubleshooting of DDC control system.

2. Validation: The automatic temperature control contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequence of operation submitted.

   a. Witnessed validation demonstration shall consist of:

      1) Execute digital and analog commands in English and graphic mode.

      2) Demonstrate all specified diagnostics.

      3) Demonstrate scan, update, and alarm responsiveness.

3. Training:

   a. All training shall be by the automatic temperature control contractor and shall utilize specified manuals and as-build documentation.

   b. Operator training shall include:

      1) Sequence of Operation review.

      2) Sign on-Sign off.

      3) Modifying warning limits, alarm limits and start-stop times.

      4) System initialization.

      5) Use of Portable Operators Terminal.

      6) Troubleshooting of sensors (determining bad sensors).

      7) Point disable/enable.

      8) Software review of Sequence of Operation programs.

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9) Modification of control programs.

10) Add/Delete/Modify data points.

11) Use of diagnostics.

12) Review of initialization.

c. Training shall be for Owner-designated personnel at the subject site, and shall be scheduled by the Owner with two week notice.

D. Installation of Gas Detection & Monitoring System:

1. This system is provided as an Emergency Vehicle exhaust system for noxious vehicle exhaust harmful to occupant's health. This system has not been designed to replace and should not be used as a substitute for the primary Vehicle exhaust system provided by the owner.

2. Provide sensors in the quantities and locations indicated on contract documents. Sensors shall be mounted in accordance with the manufacturer's recommendations and fully capable of monitoring Carbon Monoxide and Nitrogen Dioxide levels of each garage indicated in the specifications.

3. In the event the CO/NO2 sensors detect levels indicated in the specifications, the sensors shall activate the associated exhaust fan and run continuously until CO/NO2 levels in the occupied spaces return down to an acceptable safe level for the occupants.

a. All sensors shall be calibrated and installed in accordance with the manufacturer's recommendations.

4. Provided start services for Emergency Vehicle exhaust systems.

3.17 TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

A. Requirements:

1. Requirements include verification of HVAC system operation, measurement of all system capacity, and establishment of the quantities of the mechanical systems as required to meet specifications, and recording and reporting the results.

2. Commission, test, adjust and balance the following mechanical systems:

a. Supply air systems.

b. Return air systems.

c. Exhaust air systems.

d. Outside air systems.

e. Hydronic heating systems.

f. Verify temperature control system operation.

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3. Do not include:
   a. Testing boilers and pressure vessels for compliance with safety code.
   b. Installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing. Contact Mechanical Contractor and the Engineer for direction.

B. Report:
1. Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
   a. General Information and Summary.
   b. Air Systems.
   c. Hydronic heating and cooling systems.
   d. Temperature Control Systems.
2. Contents: Provide the following minimum information, forms and data:
   a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.
   b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC for each respective item and system.
   c. Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

C. Quality Assurance:
1. An independent testing, adjusting, and balancing agency certified by the AABC or NEBB as a Test and Balance Engineer in those testing and balancing disciplines required for this project.

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2. Codes and Standards:

   a. AABC: "National Standards For Total System Balance".

   b. ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

3. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect/Engineer and Mechanical Contractor. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

4. System Operation: Systems shall be fully operational prior to beginning procedures. All new automatic temperature controls shall be fully operational. Test, adjust and balance the air systems before refrigerant systems. Test, adjust and balance air conditioning systems during summer season, and heating systems during winter season, including at least a period of operation at outside conditions within 5° F. wet bulb temperature of maximum summer design condition, and within 10°F. dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.

D. Preliminary Procedures:

1. Air Systems:

   a. Obtain drawings and become thoroughly acquainted with the systems.

   b. Compare drawings to installed equipment and field installations.

   c. Walk the system from the system air handling equipment to terminal units to determine variations in installation.

   d. Check filters for cleanliness.

   e. Check all dampers (volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

   f. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a cross check with required fan volumes.

   g. Determine best locations in main and branch ductwork for most accurate duct traverses. Traverses shall be performed in each supply and return duct main and sub-mains for each AHU and return air fan.

   h. Place outlet dampers in the full open position.

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i. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

j. Verify lubrication of all motors and bearings.

k. Check fan belt tension.

l. Check fan rotation.

2. Hydronic Systems:

a. Open valves to full open position. Close coil bypass valves.

b. Remove and clean all strainers.

c. Examine hydronic systems and determine if water has been treated and cleaned.

d. Check pump rotation.

e. Check expansion tanks to verify noted air pressure and that the system is completely full of water.

f. Check air vents at high points of system and determine if all are installed and operating freely.

g. Set temperature controls so all coils are calling for full flow.

h. Check operation of automatic bypass valves.

i. Check and set operating temperatures of chillers, boilers, and heat exchangers to design requirements.

j. Verify lubrication of all motors and bearings.

3. Measurements:

a. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerance specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

b. Provide instruments meeting the specifications of the referenced standards.

c. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

d. Apply instrument as recommended by the manufacturer.

e. Use instruments with minimum scale and maximum subdivisions and with scaled ranges proper for the value being measured.

f. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5%. When

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measuring a single point, repeat readings until 2 consecutive identical values are obtained.

g. Take all reading with the eye at the level of the indicated value to prevent parallax.

h. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

i. Take measurements in the system where best suited to the task.

E. Performing Commissioning, Testing, Adjusting, and Balancing:

1. Test, adjust and balance all noted systems according to SMACNA standards and as follows:

a. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

b. Cut insulation and ductwork for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

c. Patch insulation, ductwork, and housings, using materials identical to those removed.

d. Seal ducts and test for and repair leaks.

e. Seal insulation to re-establish integrity of the vapor barrier.

f. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

g. Retest, adjust and balance system subsequent to significant system modifications, and resubmit test results.

2. System Deficiencies:

a. The Balancing Contractor shall advise the Mechanical Contractor and the Engineer of all system deficiencies in writing. Report all motors not running, missing dampers, inoperative valves and controls, lack of access, etc.

b. Upon completion of system deficiencies, Balancing Contractor shall balance and record data.

1) Any re-balancing required to meet the desired CFM or modified CFM due to system modifications or owner changes shall be provided at no additional costs to the project/owner.

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2) The Balancing Sub-subcontractor shall provide the necessary sheave and belt changes to motors and fans as required to achieve the desired CFM at no additional costs to the project/owner.

F. Subject to compliance with the above requirements and certifications, provide the services of air and water testing and balancing of one of the following:

1. Thomas Young – Marion, MA
2. Leonhardt Co. – Wellesley, MA
3. Arden Engineering – Pawtucket, RI
4. American Testing And Balancing – South Boston, MA
5. Air Balance Inc. – Woburn, MA
6. Regional Air Balance Co. – Norwood, MA
7. Tekon Technical Consultants – Rochester, NH

END OF SECTION

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DIVISON 23 HVAC

SECTION 23 05 48 VIBRATION CONTROL AND SEISMIC RESTRAINT

Filed Sub-Bid Required (HVAC)

PART 1 - GENERAL

1.00 FILED SUB-BIDS

A. Vibration Control and Seismic Restraint is stipulated as a Filed Sub-Bid under Part B, Item 2, of the FORM FOR GENERAL BID.

B. All sub-bids shall be submitted on the FORM FOR SUB-BID furnished by the Awarding Authority as required by Section 44G of Chapter 149 of the General Laws, as amended.

C. Sub-bids must be filed with the Awarding Authority in a sealed envelope, before the time stipulated in the ADVERTISEMENT, on the date stipulated in the ADVERTISEMENT.

D. Specific information relating to sub-bidders is set forth in the CONTRACT DOCUMENTS under the heading, "NOTICE TO ALL BIDDERS", and the attention of the sub-bidders is directed thereto.

E. The work to be done under this Section 23 05 48 is described herein, in Section 23 00 00, and on Drawings L1-01, D1-01 – D1-02, D2-01 – D2-02, A1-01 – A1-03, A2-01 – A2-02, A6-01 – A6-05, A9-01 – A9-03, FP0 – FP2, MD-1 – MD-3, M-1 – M-7, VS-1 – VS-2, E0.01, ED1.01 – ED1.02, E1.01 – E1.02, E2.01 – 03.

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 00 00 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect Work of this Section whether or not such Work is specifically mentioned in this Section.

C. Coordinate Work with that of all other trades affecting or affected by Work of this Section. Cooperate with such trades to assure the steady progress of all Work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the Work shall be new and of the best grade of their respective kinds.

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1.02 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 01 Section "Summary."

B. See 1.03 A below.

1.03 DESCRIPTION

A. General: The work noted within section 23 05 48 is referenced by Divisions 21 00 00, 23 00 00, and 260000. Provide all necessary labor and material in each division as required herein.

B. Intent:

1. All mechanical, plumbing, fire protection and electrical equipment, piping, and ductwork shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.

2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.

3. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.

4. All such systems must be installed in strict accordance with seismic codes, component manufacturer's, and building construction standards. Whenever a conflict occurs between the manufacturer's or construction standards, the most stringent shall apply.

5. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements (i.e. California Title 24, California OSHPD, Canadian Building Codes, or other requirements).

6. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

C. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork and equipment.

2. Equipment isolation bases.

3. Flexible piping connections.

4. Seismic restraints for isolated equipment.

5. Seismic restraints for non-isolated equipment.

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6. Certification of seismic restraint designs and installation supervision.

7. Certification of seismic attachment of housekeeping pads.

8. All mechanical, plumbing, fire protection and electrical systems. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification).

AC Units	Generators
Air Cooled Condensing Units	Heat Exchangers
Air Handling Units	Light Fixtures
Air Separators	Motor Control Ctrs
Battery Racks	Piping
Boilers	Pumps (all types)
Bus Ducts	Rooftop Units
Cable Trays	Switching Gear
Chillers	Tanks (all types)
Comp. Room Units	Transformers
Conduit	Unit Heaters
Ductwork	Unit Substations
Dust Collectors	Var. Freq. Drives
Electrical Panels	VAV Boxes
Fans (all types	Water Heaters

D. Definitions:

1. Life Safety Systems

   a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.

   b. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers, and all flowpaths to fire protection and/or emergency lighting systems.

   c. All medical and life support systems.

   d. Fresh air & relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

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2. Positive Attachment

   a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, etc. are not acceptable as seismic anchor points.

3. Transverse Bracing

   a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

4. Longitudinal Bracing

   a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.04 SUBMITTAL DATA REQUIREMENTS

A. In addition to requirements of SECTION 013300, the manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:

1. Descriptive Data

   a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.

   b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.

2. Shop Drawings

   a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.

   b. Provide all details of suspension and support for ceiling hung equipment.

   c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.

   d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

3. Seismic Certification and Analysis

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a. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.

b. All restraining devices shall have a pre-approval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 450 to the weakest mode.

c. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embodiment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces required acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.05 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes, Standards, and Categories:

1. International Building Code 2009 with an effective peak acceleration coefficient of 0.15.

2. Massachusetts State Building Code, Eighth Edition.

3. Seismic hazard exposure group of I, II, III and seismic performance category of C, D.

1.06 MANUFACTURER'S RESPONSIBILITY

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.

2. Provide vibration isolation and seismic restraints.

3. Provide calculations and materials if required for restraint of unisolated equipment.

4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.07 RELATED WORK

A. Housekeeping Pads:

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1. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embodiment.

B. Supplementary Support Steel:

1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof mounted equipment.

C. Attachments:

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.08 DESIGN REQUIREMENTS

A. Design isolators for equipment installed outdoors to provide adequate restraint to withstand the force of a 100 mph wind applied to any exposed surface of the isolated equipment. Isolators for outdoor equipment shall have bolt holes for attachment to equipment and to supports. The vibration isolation Vendor shall submit verifying shear and over turning calculations, for their product and equipment installation arrangement, stamped by a licensed Professional Engineer. The design and supply of miscellaneous support steel above and below isolators will not be the responsibility of the vibration isolation manufacturer.

1.09 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes, with the proper loading to meet the specified deflection requirements.

C. Supply and install any incidental materials such as mounting brackets, attachments and other accessories as may be needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim for additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

E. Should any rotating equipment cause excessive noise or vibration when properly installed on the specified isolators, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

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PART 2 - PRODUCTS

2.01 INTENT

A. All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer. Mason Industry's products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification.

B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8 inch and/or horizontal permanent deformation greater that 1/4 inch.

2.02 PRODUCT DESCRIPTIONS

A. Vibration Isolators and Seismic Restraints.

GENERAL:

1. All metal parts installed out-of-doors shall be corrosion resistant after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.

2. Isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.

3. Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor-saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories and seismic restraint features must not degrade the isolation performance of the isolators.

4. Static deflection of isolators shall be as provided in the EXECUTION section and as shown on the drawings. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.

SPECIFICATION:

1. Two layers of 3/4" thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 1 6 gauge galvanized shim. Load distribution plates shall be used as required. Pads shall be Type Super "W" as manufactured by Mason Industries, Inc.

2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central

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threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be Type BR as manufactured by Mason Industries, Inc.

3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in 3 planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge bearing quality. Bushing assemblies shall be type PB as manufactured by Mason Industries, Inc.

4. A one (1) piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact. Neoprene bushings shall be type HG as manufactured by Mason Industries, Inc.

5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be Type SLF as manufactured by Mason Industries, Inc.

6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Pre-approval "R" Number from OSHPD

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in the state of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be SLR as manufactured by Mason Industries, Inc.

7. Spring mountings as in specification 5 built into ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of 1/4 inch travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be SSLFH as manufactured by Mason Industries, Inc.

8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air Springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8". Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician. Air Springs shall be Type MT and leveling valves Type LV as manufactured by Mason Industries, Inc.

9. Restrained air spring mountings shall have an MT air spring as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces. Mountings shall be SLR-MT as manufactured by Mason Industries, Inc.

10. Hangers shall consist of rigid steel frames containing minimum 1 1/4" thick neoprene elements at the top and a steel spring with general characteristics as in specification 5 seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing

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showing the 30° capability. Hangers shall be type 30° as manufactured by Mason Industries, Inc.

11. Hangers shall be as described in specifications 10, but they shall be pre-compressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.

12. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be Type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam all as manufactured by Mason Industries, Inc.

13. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage pre-approval "R" number from OSHPD in the state of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be type SSB as manufactured by Mason Industries, Inc.

Note: Specifications 12 - 14 apply to trapeze as well as clevis hanger locations. At trapeze anchor locations piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

14. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California. Rod clamp assemblies shall be Type SRC as manufactured by Mason Industries, Inc.

15. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose performed channels deep enough to be held in

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place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.

16. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4 inch thick. Rated loading shall not exceed 1,000 psi. A minimum air gap of 1/8 inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be Type Z-1 225 as manufactured by Mason Industries, Inc.

17. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" thick. Rated loadings shall not exceed 1,000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" nor more that 1/4". Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to 1/2" deflection in the x, **y** and z planes. Snubbers shall have an anchorage pre-approval "R" number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be series Z-101 1 as manufactured by Mason Industries, Inc.

18. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.0 Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS as manufactured by Mason Industries, Inc.

19. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an evaluation report number from the I.C.B.0 Evaluation Service, Inc. verifying to its allowable loads. Drill-in female

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wedge anchors shall be type SAB as manufactured by Mason Industries, Inc.

20. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14' provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 ". Bases shall be type WF as manufactured by Mason Industries, Inc.

21. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/1 2 of the longest dimension of the base but not less than 6". The base depth need not exceed 1 2" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 6" centers running both ways in a layer 1 1/2" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1 " clearance below the base. Wooden formed bases leaving a concrete rather then a steel finish are not acceptable. Base shall be type BMK or K as manufactured by Mason Industries, Inc.

22. Roof Curb (by HVAC Contractor)

    a. Curb mounted rooftop equipment shall be mounted on structural spring isolation curbs that bear directly on the roof support structure, and are flashed and waterproofed into the roof's membrane waterproofing system. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal. Springs shall be Type A.

    b. Unit shall be provided with wood nailer and flashing.

    c. Curbs shall meet all NRCA Standards.

    d. Curbs shall be similar to Novia Associates VibCurb III or equal having a minimum 3" rated static deflection or approved equal.

    e. Vibration control: The spring roof curb shall have the top isolated or floating rail attached in a manner to the fixed lower portion of the curb without short circuiting or bridging between the two.

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Restraining bolt(s) or threaded rod shall be of sufficient size to withstand the applied wind & or seismic forces at each spring pack location.

f. An alignment bolt shall be installed before connecting the floating to non-floating parts to guarantee perfect centering of the restraining bolts.

g. Weather proofing & air seal: The spring curb must keep the weather (air and water) out and any airflow from the RTU in. The weather seal must not have the ability to fail and allow water or air into the building.

h. The use of exposed exterior neoprene or some other elastomer material to seal the top floating rail from the base of the curb in not acceptable.

i. Vibration Mountings: Provide a rubber gasket covered by formed galvanized sheet metal top flashing that overhangs the top wood nailer and galvanized bottom flashing. The overlapping shall effectively cover the rubber gasket so it is protected from the elements.

j. The top flashing / support rail shall be 14 ga. G60–Zc steel formed with 90 bends that extend down to the wood nailer. Provide a counter flashing member with a sponge gasket attached that presses up against the horizontal bend. The seal shall be replaceable, protected from the elements and easy to install.

k. Curb side material: Provide 12 Ga. G60 galvanized steel for curb side construction. All side and end seam between sheets shall be continuously welded, corner joints to be caulked and bolted.

l. Structural Capability:

1) Curbs shall be installed on metal decking/concrete slab. Air handling unit load shall be properly distributed. Coordinate curb construction with pitch of roof. Curbs shall be built to match the roof pitch in accordance with all requirements of this project. Positive attachment of the curb to the structure is imperative. Pitch correction shall be fabricated from 12 gauge galvanized material and be continuous on all sides and ends. Field fabricated and installed tube steel stub-ups are not acceptable. HVAC contractor shall provide detailed information to the curb manufacturer regarding pitch correction.

2) Plenum Sections: The side material must be capable of handling the static pressure developed by the fans and not ‘oil can’. Provide spanning bar joists as required to support

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plenum installation (even when the spring pockets are center span).

3) Provide a continuous bottom tube steel member or side material of sufficient strength. Mechanical contractor shall coordinate and verify all dimensions, weights, roof penetrations, etc. with the Structural Engineer prior to installation.

4) Curb Insulation: Provide spring curbs with a space between the floating and non-floating parts for the installation of insulation. Curb manufacturer shall provide factory installed insulation adhered to roof curb. Curbs shall be externally factory insulated with a 1.7" thick R-12 foam insulation, FM Class 1 and UL Class A Ratings, with bonded fiber reinforced facer.

m. Protection: Curbs shall be completely shrink-wrapped during shipping.

n. Mechanical contractor shall provide all necessary materials to completely weather proof and sound proof the curb installation.

o. Additional features:

1) Sound barrier: Provide a sound barrier package, consisting of G60 galvanized back-to-back angles. Sound barrier package shall be capable of supporting two layers of 1/2" Durock concrete board with a maximum deflection over the width of the curb of L/360. Durock furnished and installed by the HVAC Contractor. Overlap all joints, caulk all seams and edges. Transmission Loss & STC shall be as shown as follows. Sound Transmission Loss at Frequency (Cycles per second) of (125)=20, (250)=27, (500)=30, (1000)=32, (2000)=30, (4000)=38, (STC)=31.

2) Provide with framed Supply & Return air duct openings. Openings shall match duct sizes and have 1" galvanized steel flanges.

3) Plenum sections: Where indicated on the drawings, provide in the interior of the curb, double wall acoustical floor, walls and plenum divider. All insulation shall be 2" thick fiber glass acoustical duct liner with reinforced coating system. Insulation acoustical performance shall be as follows. Liner shall not support microbial growth and shall be EPA registered and pass ASTM C 1071 & ASTM G21 bacterial tests conducted in accordance with ASTM G22. Floors up to 90" curb I.D. width shall be constructed of 22

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Ga., 20 Ga. thereafter, solid G60 galvanized bottom panels and 22 Ga. galvanized perforated 22.7% open area top panel. Floor shall be attached to walls and plenum divider to provide an airtight plenum. Walls shall have 22 Ga. galvanized perforated 22.7% open area inside panels. Plenum divider shall be double wall 22 Ga. perforated galvanized 22.7% open area panel on the supply side with a 14 gauge solid panel opposite. Sound Absorption Coefficient at Frequency (Cycles per second) of (125)=.23, (250)=.64, (500)=.99, (1000)=1.05, (2000)=1.00, (4000)=.98, (NRC)=.90,

23. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Dacron tire cord friction ring. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16' to 24" may be single sphere. Sizes 3/4" to 1 1/2" may have threaded bolted flange assemblies, one sphere and cable retention. 14" and smaller connectors shall be rated at 250 psi up to 190°F. with a uniform drop in allowable pressure to 190 psi at 250°F. 16" and larger connectors are rated 180 psi at 190°F. and 135 psi at 250°F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.

Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have 1/2" thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut off valves.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

24. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

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Flanged		Male Nipples	
3 x 14	10 x 26	½ x 9	1-½ x 13
4 x 15	12 x 28	¾ x 10	2 x 14
5 x 19	14 x 30	1 x 11	2-1/2 x 18
6 x 20	16 x 32	1-1/4 x 12	
8 x 22			

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS as manufactured by Mason Industries, Inc.

25. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.

26. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of $\pm$ 1 5/8" motion, or to meet location requirements. Pipe guides shall be type VSG as manufactured by Mason Industries, Inc.

27. Split Wall Seals consist of two bolted pipe halves with minimum 3/4" thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of I" past either face of the wall. Where temperatures exceed 240°F., 10# density fiberglass may be used in lieu of the sponge. Seals shall be Type SWS as manufactured by Mason Industries, Inc.

28. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted

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in the field to allow for a maximum of 1/4" movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the duct work or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD as manufactured by Mason Industries, Inc.

PART 3 - EXECUTION

3.01 GENERAL

A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data. At the completion of all construction work the vibration and seismic device supplier shall inspect all installations and provided a written report of installation compliance to the engineer of record. A copy of this written certification shall also be provided in the operations manual provided to the owner.

B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

D. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate work with other trades to avoid rigid contact with the building.

F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractors expense.

G. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractors expense.

H. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractors expense.

I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:

1. Flanges of structural beams.

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2. Upper truss cords in bar joist construction.

3. Cast in place inserts or wedge type drill-in concrete anchors.

J. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.

K. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.

L. At locations where specification 12 or 13 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 14 braces.

M. At all locations where specification 12 or 13 restraints are attached to pipe clevis's, the clevis cross bolt must be reinforced with specification type 15 braces.

N. Drill-in concrete anchors for ceiling and wall installation shall be specification type 18, and specification type 19 female wedge type for floor mounted equipment.

O. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.

P. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed specification 23 capabilities.

Q. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide specification 27 wall seals.

R. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be specification type 28.

S. Locate isolation hangers as near to the overhead support structure as possible.

3.02 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF PIPING, DUCTWORK, AND CONDUIT

A. Where piping connects to rotating or vibrating mechanical equipment install specification 23 expansion joints or specification 24 stainless hoses if 23 is not suitable for the service.

B. Seismic Restraint of Piping:

1. Seismically restrain all piping listed as a, b or c below. Use specification 12 cables.

a. Fuel oil piping, gas piping, medical gas piping, and compressed air piping.

b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1 1/4" I.D. and larger.

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c. All other piping 2 1/2" diameter and larger.

2. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.

3. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.

4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.

5. For fuel oil and all gas piping transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.

6. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.

7. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.

8. Branch lines may not be used to restrain main lines.

C. Pipe Isolation

1. All chilled water, condenser water, hot water, steam, refrigerant, drain and engine exhaust piping that is connected to vibration-isolated equipment shall be isolated from the building structure within the following limits:

Within mechanical rooms;

Within 50' total pipe length of connected vibration-isolated equipment (chillers, pumps, air handling units, pressure reducing stations, etc.);

At every support point for piping that is greater than 4 inches in diameter.

2. Piping shall be isolated from the building structure by means of vibration isolators, resilient lateral supports, and resilient penetration sleeve/seals.

3. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than 1/2", Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to 1/2", Type FN or HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or HN achieving at least 1/4" static deflection.

4. Where lateral support of pipes is required within the specified limits, this shall be accomplished by use of resilient lateral supports.

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5. Pipes within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.

6. Provide flexible pipe connections as called for under Major Equipment above and wherever shown on the drawings.

D. Seismic restraint of ductwork:

1. Seismically restrain all duct work with specification 12 or 13 restraints as listed below:

   a. Restrain rectangular ducts with cross sectional area of 6 sq. ft. or larger.

   b. Restrain round ducts with diameters of 28" or larger.

   c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.

2. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.

3. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4' of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.

4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.

5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.

6. Walls, including gypsum board non bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.

E. Duct Isolation:

1. All sheet metal ducts and air plenums that are within mechanical rooms or within a distance of 50' total duct length of connected vibration-isolated equipment (whichever is longer) shall be isolated from the building

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structure by Type FN, PCF or HN isolators. All isolators shall achieve 0.1" minimum static deflection.

2. Ducts within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.

3. Flexible duct connections shall be provided as called for above under Major Equipment and wherever shown on the drawings.

F. Seismic Restraint of Electrical Services:

1. All electrical conduit 2-1/2" in diameter and larger shall be restrained with specification type 12 seismic cable restraints or specification type 13 for seismic solid brace restraints.

2. All electrical bus ducts, cable trays and ladder trays shall be restrained with specification type 12, seismic cable restraints or specification 13 seismic solid brace restraints.

3. Transverse restraints shall occur at 30' intervals or both ends if the electrical run is less than the specified interval. Transverse restraints shall be installed at each electrical services turn and at each end of the electric run.

4. Longitudinal restraints shall occur at 60' intervals with at least one restraint per electric run. Transverse restraints for one electric section may also act as a longitudinal restraint for a duct for an electric section connected perpendicular to it if the restraints are installed within 4' of the intersection of the electric run and if the restraints are sized for the larger electric run.

5. All rigid floor mounted equipment must have a resilient media between the equipment mounting hole and the anchor bolt. Neoprene bushings shall be specification type 4 and anchor bolts shall be specification type 18 or 19.

6. Wall mounted panels shall be mounted with specification type 3 bushings. Floor mounted panels shall be mounted on specification type 4 bushings. Anchor bolts shall be specification type 18 or 19.

G. All fire protection piping shall be braced in accordance with NFPA 13 and 14.

H. All mechanical equipment shall be vibration isolated and seismically restrained.

1. All fire protection equipment is considered life safety equipment and shall be seismically restrained.

3.03 SEISMIC RESTRAINT EXCLUSIONS

A. Piping:

1. All piping less than 2 1/2” except for gas and fire protection piping.

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2. All piping in boiler and mechanical equipment rooms less than 1 1/4" I.D.

3. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12" in length from the structure to the structural connection of the clevis or trapeze.

4. All PVC and fiberglass suspended waste or vent pipe 6" in diameter and smaller.

B. Ductwork:

1. Rectangular, square or oval ducts less than 6 sq.ft. in cross sectional area.

2. Round duct less than 28" in diameter.

3. Duct supported by hanger rods where the point of attachment is less than 12" in length from the structure to the structural connection of the duct work.

C. Electrical:

1. All conduit less than 2 1/2" diameter suspended by individual hanger rods.

2. All clevis or trapeze supported conduits suspended by hanger rods where the point of attachment is less than 1 2" in length from the structure to the structural connection of the clevis or trapeze.

3.04 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.

2. Installation of vibration isolation equipment shall be in accordance with the manufacturer's instructions.

B. Isolators

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.

2. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the equipment shaft unless this is not possible because of physical constraints.

3. Locate isolators to provide stable support for equipment, without excess rocking.

Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called for herein.

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4. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.

5. Hanger rods for vibration-isolated support shall be connected to major structural

   members, not the floor slab between major structural members. Provide suitable

   intermediate support members as necessary.

6. Vibration isolation hanger elements shall be positioned as high as possible in the

   hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.

7. Parallel running pipes may be hung together on a trapeze that is isolated from the

   building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and unisolated pipes on the same trapeze.

8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.

9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.

10. The installed and operating heights of equipment supported by Type FSNTL isolators or with Type RC-2 isolation bases shall be identical. Limit stops shall be out of contact during normal operation. Adjust isolators to provide 1/4" clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.

11. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the

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equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.

2. Unless otherwise indicated, there is to be a minimum operating clearance of 1" between steel rails, steel frame bases or inertia bases and the floor beneath the equipment. The isolator mounting brackets shall be positioned and the isolators adjusted so that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

3. Isolation bases shall be installed in strict accordance with the manufacturer's instructions.

D. Flexible Duct Connections:

1. Prior to installation of the flexible connection, sheet metal ducts and plenum openings shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section, and the gap between connected parts shall be uniform. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

E. Flexible Pipe Connections:

1. Install flexible pipe connections in strict accordance with the manufacturer's instructions.

F. Thrust Restraints:

1. Thrust restraints shall be attached on each side of the fan parallel to the thrust force. This may require custom brackets or standoffs. The body of the thrust restraint shall not come in contact with the connected elements. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.

G. Grommets:

1. Where grommets are required at hold down bolts of isolators, bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers shall be galvanized.

H. Resilient Penetration Sleeve/Seals:

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

END OF SECTION

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DIVISION 26 ELECTRICAL

SECTION 26 00 00 ELECTRICAL

(Filed Sub-Bid Required - Electrical)

PART 1 - GENERAL

1.00 FILED SUB-BIDS

A. Vibration Control and Seismic Restraint is stipulated as a Filed Sub-Bid under Part B, Item 2, of the FORM FOR GENERAL BID.

B. All sub-bids shall be submitted on the FORM FOR SUB-BID furnished by the Awarding Authority as required by Section 44G of Chapter 149 of the General Laws, as amended.

C. Sub-bids must be filed with the Awarding Authority in a sealed envelope, before the time stipulated in the ADVERTISEMENT, on the date stipulated in the ADVERTISEMENT.

D. Specific information relating to sub-bidders is set forth in the CONTRACT DOCUMENTS under the heading, "NOTICE TO ALL BIDDERS", and the attention of the sub-bidders is directed thereto.

E. The work to be done under this Section 23 05 48 is described herein and on Drawings L1-01, D1-01 – D1-02, D2-01 – D2-02, A1-01 – A1-03, A2-01 – A2-02, A6-01 – A6-05, A9-01 – A9-03, FP0 – FP2, MD-1 – MD-3, M-1 – M-7, VS-1 – VS-2, E0.01, ED1.01 – ED1.02, E1.01 – E1.02, E2.01 – 03.

1.01 GENERAL REQUIREMENTS

A. Include the General Conditions, Modifications to the General Conditions, and applicable parts of Division 01 00 00 as part of this Section.

B. Examine all other Sections of the Specifications for requirements which affect Work of this Section whether or not such Work is specifically mentioned in this Section.

C. Coordinate Work with that of all other trades affecting or affected by Work of this Section. Cooperate with such trades to assure the steady progress of all Work under Contract.

D. It is the intent of the Specifications and the Drawings to require that all the material, labor, and equipment be furnished complete in every respect, and that this Contractor shall provide all material, labor, and equipment needed and usually furnished in connection with such systems to provide a complete installation including all demolition, disposal, and patching of adjacent surfaces. Materials, equipment, and articles incorporated in the Work shall be new and of the best grade of their respective kinds.

1.02 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Documents

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identified in Division 01 Section "Summary", Paragraph 1.01A, entitled "Related Documents."

1.03 WORK TO BE PERFORMED

A. Work described herein shall be interpreted as work to be done by the Electrical Subcontractor. Work to be performed by other trades will be referenced to a particular contractor or subcontractor.

B. Provide all labor, materials, tools, and equipment, to complete the installation of the electrical system. Install, equip, adjust, and put into operation the respective portions of the installation specified, and so interconnect various items or sections of work in order to form a complete and operating whole. Systems may be referenced in singular or plural terms, also refer to drawings to confirm quantities. The work shall consist of, but shall not necessarily be limited to, the following:

1. Secondary distribution equipment modifications, disconnect switches including feeders and subfeeders.
2. Fire alarm system extension.
3. Emergency lighting will connect to existing emergency panels.
4. Lighting systems, including fixtures, lamps, and controls.
5. All raceway systems, including boxes, couplings, and fittings.
6. All branch circuit wiring systems, including wiring devices, plates.
7. Connections for all building equipment, including HVAC and plumbing.
8. All testing of equipment installed.
9. Any other item of work hereinafter specified or indicated on electrical drawings.
10. Drilling, Coring, and Cutting of holes and openings where the largest dimension thereof does not exceed 12 inches, for Electrical conduit, wiring, and Equipment.
11. Scaffolding, Rigging, and Staging required for all Electrical work.
12. Fire stopping shall be performed by Electrical Contractor.
13. Provide Seismic Restraints for all Electrical Systems conforming to Massachusetts State Building Code.
14. Modifications to existing panelboards and switchboard.
15. Phasing and Demolition.
16. Sealing of all penetrations that are not fire rated.
17. Telephone and data wiring by E.C.

1.04 DEFINITIONS

A. Most terms used within the documents are industry standard. Certain words or

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phrases shall be understood to have specific meanings as follows:

1. Provide: Furnish and install completely connected up and in operable condition.
2. Furnish: Purchase and deliver to a specific location within the building or site.
3. Install: With respect to equipment furnished by others, install means to receive, unpack, move into position, mount and connect, including removal of packaging materials.
4. Conduit: Raceways of the metallic type which are not flexible. Specific types as specified.
5. Connect: To wire up, including all branch circuitry, control and disconnection devices so item is complete and ready for operation.
6. Subject to Mechanical Damage: Equipment and raceways installed exposed and less than eight feet above finished floor in mechanical rooms or other areas where heavy equipment may be in use or moved.

1.05 ITEMS TO BE FURNISHED ONLY

A. Furnish the following items for installation under designated sections.

1. None.

1.06 ITEMS TO BE INSTALLED ONLY

A. Install the following items furnished under designated sections.

1. None.

1.07 RELATED WORK

A. The following related work is to be performed under designated sections.

1. Cutting beyond 1.03, B.11 above and patching of all openings regardless of size will be by the respective Sections of the trade responsible for surface on which opening is made.
2. Temporary Lighting and Power: Section 011000 – General Requirements.
3. Finish painting: Section 099100 -Painting
4. Payment for energy for temporary light and power will be by owner.

1.08 CONTRACT COST BREAKDOWN

A. Submit a breakdown of contract price to aid Architect in determining value of work installed as job progresses.

1.09 INSPECTION OF SITE

A. Electrical bidders shall inspect site. Failure to inspect existing conditions or to fully understand work which is required shall not excuse Electrical Subcontractor from his obligations to supply and install work in accordance with specifications

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and the drawings and under all site conditions as they exist.

1.10 CONTRACTOR'S REPRESENTATIVE

A. Retain a competent representative on the project.

1.11 COOPERATION

A. Work shall be carried on under usual construction conditions, in conjunction with other contractors work. Cooperate with other contractors, coordinate work and proceed in a manner as not to delay progress.

B. Before proceeding, examine all construction drawings and consult other contractors to coordinate installation and avoid interference.

C. In case of dispute, the Architect will render a decision in accordance with General and Supplementary General Conditions.

1.12 CODES, ORDINANCES, AND PERMITS

A. Codes and Ordinances:

1. All material and work provided shall be in accordance with the following codes and standards as most recently amended.

State of Massachusetts Building Code

Massachusetts Electric Code, 2017 Edition

State Department of Public Safety

NFPA 101 "Life Safety Code"

NFPA Standards

Standards of the Underwriters Laboratories (UL)

Occupational Safety and Health Act (OSHA)

Americans with Disabilities Act (ADA)

Energy Conservation Code

Town of Barnstable

2. Where contract documents indicate more stringent requirements than codes, the contract documents shall take precedence.

B. Permits: Be responsible for filing documents, payment of all fees and securing of inspection and approvals. Refer to instructions to bidders.

1.13 ELECTRICAL ROOMS OR SPACES

A. Be responsible for ensuring that the dedicated space and clearances required in the NEC, Sections 110-26 and 110-16 are maintained for all electrical equipment.

B. Call other contractors' attention to the requirements contained in the above mentioned code sections, prior to the installation of equipment by other contractors, in order to ensure no violations.

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1.14 SUBMITTALS

A. Refer to Supplementary General Conditions for information relative to submission of shop drawings. Six (6) copies are required. No equipment for which review is required shall be installed prior to review, except at Contractor's own risk. Shop Drawings will be required for all electrical equipment.

B. Notwithstanding any restrictions upon contractor proposed substitutions, should apparatus or materials be permitted by Architect to be substituted for those specified for good cause, and such substitution necessitates changes in or additional connections, piping, supports, or construction, same shall be provided. Assume cost and entire responsibility thereof.

C. Submit the following samples:

1. Lighting fixtures as may be requested.

2. Other items as may be requested.

1.15 GUARANTEE

A. Keep work in repair without expense to Owner as far as concerns defects in workmanship or materials for a period of not less than one year from date of substantial completion.

1.16 ELECTRICAL CHARACTERISTICS

A. In general, and unless specifically indicated otherwise, all building service, heating, ventilating, air conditioning, and plumbing equipment shall be of the following characteristics.

1. Motors up to and including 1/3 HP shall be suitable for 120 volts, one phase operation.

2. Motors larger than 1/3 HP shall be suitable for 480 volts, three phase operation.

3. Electric heating equipment 1.5 KW and less shall be suitable for 120 volt single phase operation. Over 1.5KW shall be 480 volt three phase.

B. Power Factor: All equipment provided rated greater than 1,000 watts and lighting equipment greater than 15 watts with an inductive reactance load component shall have a power factor of not less than 90 percent under rated load conditions.

1.17 TEMPORARY LIGHT & POWER

A. Refer to SECTION 011000 – General Requirements.

1.18 TEMPORARY ELECTRICAL SUPPORT FACILITIES

A. Refer to and comply with SECTION 011000, General Requirements and the following:

1. Provide own field office and/or storage facilities which shall be located as directed or permitted by General Contractor and in accordance with local regulations. Provide all tools, equipment, ladders, and temporary

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construction required for execution of the work.

2. All scaffolding, ladders, and other temporary construction shall be rigidly built in accordance with all local and state requirements, and shall be removed upon completion.

1.19 RECORD DRAWINGS

A. Refer and comply with SECTION 011000, General Requirements and the following;

B. Provide two sets of black or blue line on white drawings to maintain and submit record drawings, one set shall be maintained at site and which shall be accurate, clear, and complete showing actual location of all equipment as installed. Record drawings shall be updated at least monthly. Record drawings shall show outlet from which homeruns are taken, and location of all junction boxes and access panels. These drawings shall be available to Architect/Engineer field representative.

C. Any addenda sketches and supplementary drawings issued during course of construction shall be attached to drawings.

D. At completion, submit an accurate checked set of drawings.

E. After approval of these drawings, photo reproductions of original tracings shall be revised to incorporate changes, including addenda sketches and supplementary drawings. These “as-built” photo reproductions shall be certified as correct and delivered to the Architect along with two sets of black line prints. Provide an Auto-Cad CD of the as-built drawings.

1.20 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Refer to and comply with SECTION 011000, General Requirements and the following:

B. Operating Instructions: Furnish operating instructions to Owner's designated representative with respect to operations, functions and maintenance procedures for equipment and systems installed. Cost of such instruction up to a full three (3) days of Electrical Subcontractor's time shall be included in contract. Cost of providing a manufacturer's representative at site for instructional purposes shall also be included.

C. Maintenance Manuals:

1. Provide four copies of complete manuals containing the following:

a. Complete shop drawings of equipment.

b. Operation description of systems.

c. Names, addresses, and telephone numbers of suppliers of systems.

d. Vendors' P.O. numbers for equipment installed.

e. Preventive maintenance instructions for systems.

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f. Spare parts list of system components.

2. All information shall be in binders.

1.21 INSPECTIONS AND TESTS

A. Inspection: If inspection of materials installed shows defects, such defective work, materials, and/or equipment shall be replaced and inspection and tests repeated.

B. Tests: Make reasonable tests and prove integrity of work and leave electrical installation in correct adjustment and ready to operate. All panels and switchboards shall have phases balanced as near as practical. A consistent phase orientation shall be adhered to at all terminations.

1.22 RETURN AIR PLENUM

A. All wiring above hung ceilings shall either be run in conduit or be "UL listed" plenum cable.

1.23 PHASING, DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, required relocation, rerouting, etc., of existing equipment and systems in the existing building areas where new work is to be installed or new connections are scheduled to be made, shall be performed by the Electrical Subcontractor, as required by job conditions and as determined by the Architect in the field, to facilitate the installation of the new system, while demolition, relocation work or new tie-ins will be performed. Outages required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the Owner's designated representative, for specified, mutually agreeable periods of time, after each of which the interruption shall cease and the service shall be restored. This procedure shall be repeated to suit the Owner's working schedule, as many times as required until all work is complete. Any outages of service shall be approved by the Owner, prior to commencing the work. No outages or shutdowns of service shall occur without the written authorization of the Owner prior to commencing the work. Give notice of any scheduled shutdowns, a minimum of two weeks in advance. Owner shall make their best effort to meet this request without adversely affecting the electric service to the existing building.

B. Prior to any deactivation and relocation or demolition work, consult the drawings and arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.

C. Where existing outlets are to be reused and are cut off by the remodeling, they shall be reconnected to existing circuits as required by field conditions. Where existing outlets are to be abandoned, they shall be removed and blank plates installed. Each bidder shall, before submitting his bid, visit the site and make a thorough examination of the conditions in the existing buildings in order to

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determine the extent of the work to be done.

D. All deactivation, relocation and temporary tie-ins of electrical systems and equipment shall be provided by the Electrical Subcontractor. All demolition and removal of electrical systems and equipment designated to be demolished shall be by the Electrical Subcontractor. Stack all demolished electrical materials except hazardous materials (PCB lighting ballasts, fluorescent lamps, etc.) nearby for removal by the General Contractor. All hazardous electrical materials shall be stacked as directed by General Contractor and shall be legally disposed by the General Contractor. The General Contractor will be removing the lamps and ballasts from the fixtures.

E. The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.

F. Phasing

1. The Electrical Subcontractor shall construct the subject in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

2. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the Architectural drawings

PART 2 PRODUCTS

2.01 GENERAL

A. Product specifications are written in such a manner so as to specify what materials may be used in a particular location or application and therefore do not indicate what is not acceptable or suitable for a particular location or application. As an example: non-metallic sheathed cable is not specified; therefore, it is not acceptable.

B. For purpose of establishing a standard of quality and not for purpose of limiting competition, the basis of this Specification is upon specified models and types of equipment and materials, as manufactured by specified manufacturers.

C. In all cases, standard cataloged materials and systems have been selected. Materials such as lighting fixtures specially manufactured for this particular project and not part of a manufacturers' standard product line will not be acceptable. In the case of systems, the system components shall be from a single source regularly engaged in supplying such systems. A proposed system made up of a collection of various manufacturers' products will be unacceptable.

D. Where Specifications list manufacturers' names and/or "as approved" or "Equal approved by Architect", other manufacturers' equipment will be considered if equipment meets Specification requirements and has all features of the specified items as are considered essential by Architect.

E. All material shall be new and shall be UL listed.

2.02 RACEWAYS AND FITTINGS

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A. Raceways - General:

1. No raceway shall be used smaller than 3/4" diameter and shall have no more than four 90 deg. bends in any one run, and where necessary, pull boxes shall be provided. Only rigid metal conduit or intermediate metal conduit is allowed for slab work. Cable systems, if allowed to be used by other sections of this specification, shall not be used exposed or in slabs, whether listed by "UL" for such use or not.

2. Rigid metal conduit conforming to, and installed in accordance with, Article 344 shall be heavy wall zinc coated steel conforming to American Standard Specification C80-1 and may be used for service work, exterior work, slab work, and below grade level slab, wet locations, where raceway may be subject to mechanical damage.

3. Intermediate metal conduit conforming to, and installed in accordance with Article 342, may be used for all applications where rigid metal conduit is allowed by these specifications.

4. Electrical Metallic Tubing (EMT), conforming to, and installed in accordance with, Article 358 shall be zinc coated steel, conforming to industry standards, may be used in masonry block walls, stud partitions, above furred ceilings, where exposed but not subject to mechanical damage, and may be used for fire alarm work.

5. Surface metal raceways conforming to, and installed in accordance with, Article 386 shall be used where raceways cannot be run concealed in areas accessible to the public including classrooms, corridors, offices, etc.

6. Flexible metal conduit shall be used for final connections to recessed lighting fixtures from above ceiling junction boxes and for final flexible connections to motors and other rotating or vibrating equipment. Liquid tight flexible metal conduit shall be used for the above connections which are located in moist locations. All flexible connections shall include an insulated grounding conductor.

7. Rigid non-metallic conduit may be used for underground electric and low tension services outside the foundation wall and shall be polyvinyl chloride (PVC) schedule 40, 90 deg. C. PVC schedule 40 may also be used below slab.

   PVC Schedule 40 shall not be used in slabs, or where it penetrates slab or foundation wall. PVC Schedule 40 may be used for outside feeders and branch circuits. Below slab conduits do not require concrete encasement.

8. Acceptable manufacturers:

   a. Pittsburgh Standard Conduit Company

   b. Republic Steel and Tube

   c. Youngstown Sheet and Tube Company

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d. Carlon

e. Or equal.

9. Fittings:

a. Provide insulated bushings on all raceways 1 inch diameter or larger.

b. Manufacturer's standard fittings shall be used for raceway supports.

c. Expansion Fittings: Expansion fittings shall be used where structural and concrete expansion joints occur and shall include a ground strap.

d. Couplings for rigid metal and intermediate metal conduit shall be threaded type.

e. Threadless fittings for EMT shall be watertight compression type or set-screw type (dry-locations). All fittings shall be concrete tight. No diecast fittings allowed except for raceways larger than 1 inch diameter.

f. Cable supports in vertical raceways shall be of the split wedge type. Armored cable supports for vertical runs to be of wire mesh basket design.

g. Wall entrance seals shall be equal to O.Z. Gedney type "WSK".

h. Couplings, elbows and other fittings used with rigid nonmetallic conduit shall be of the solvent cemented type to secure a waterproof installation.

i. Acceptable manufacturers:

1) O.Z.

2) Crouse Hinds

3) Appleton

4) EFCOR

5) Steel City

6) Or equal

B. Outlets, Pull and Junction Boxes:

1. Outlets:

a. Each outlet in wiring or raceway systems shall be provided with an outlet box to suit conditions encountered. Boxes installed in normally wet locations or surface mounted shall be of the cast-metal type having hubs. Concealed boxes shall be cadmium plated or zinc coated sheet metal type. Old work boxes with

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Madison clamps not allowed in new construction. Thru the wall boxes are not permitted.

b. Each box shall have sufficient volume to accommodate number of conductors in accordance with requirements of Code. Boxes shall not be less than 1-1/2 in. deep unless shallower boxes are required by structural conditions and are specifically approved by Architect. Ceiling and bracket outlet boxes shall not be less than 4 in. octagonal except that smaller boxes may be used where required by particular fixture to be installed. Flush or recessed fixtures shall be provided with separate junction boxes when required by fixture terminal temperature requirements. Switch and receptacle boxes shall be 4 in. square or of comparable volume.

c. Far side box supports shall be Caddy J-1A.

d. Acceptable manufacturers:

1) Appleton

2) Crouse Hinds

3) Steel City

4) RACO

5) Or equal

2. Pull and Junction Boxes: Where indicated on plans, and where necessary to terminate, tap off, or redirect multiple raceway runs or to facilitate conductor installation, furnish, and install appropriately designed boxes. Boxes shall be fabricated from code gauge steel assembled with corrosion resistant machine screws. Box size shall be as required by Code.

Boxes in moist or wet areas shall be galvanized type. Boxes larger than 4-11/16 inches square shall have hinged covers. Boxes larger than 12 inches in one dimension will be allowed to have screw fastened covers, if a hinged cover would not be capable of being opened a full 90 degrees due to installation location.

a. Acceptable Manufacturers:

1) Brasch

2) Hoffman

3) Keystone

4) Lee Products Co.

5) McKinstry Inc.

6) Eldon Inc.

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7) Or equal

2.03 CONDUCTORS

A. All conductors shall be a minimum size of #12 AWG except for control wiring and fire alarm wiring where #14 AWG may be used. For all exit sign circuits, normal/emergency and/or emergency only circuits, exterior lighting circuits, and also where distance from panelboard to first outlet exceeds 80 ft. at 120 volts and 150 ft. at 277 volts, #10 AWG shall be minimum size wire allowed. All feeder and branch circuit conductor shall be color coded as follows:

1.	208Y/120V	Phase A	Black
2.	208Y/120V	Phase B	Red
3.	208Y/120V	Phase C	Blue
4.	480Y/277V	Phase A	Brown
5.	480Y/277V	Phase B	Orange
6.	480Y/277V	Phase C	Yellow

7. Grounded Conductor

120/208	White
277/480	Grey

8. Equipment Ground

120/208	Green
277/480	Green with Yellow Trace

B. All conductors not installed in accordance with color scheme shall be replaced. All conductors larger than #6 AWG must be identified with colored tape.

C. Connections throughout the entire job shall be made with solderless type devices.

1. For #10 AWG and smaller: spring type.
2. For #8 AWG and larger: circumferential compression type.
3. Acceptable manufacturers:
   a. 3M "Scotchlock"
   b. IDEAL "Wingnut"
   c. BURNDY
   d. MAC
   e. Or equal.
4. Any splices made up in ground mounted pull boxes shall be resin cast waterproof type or waterproof pressure type.

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D. Conductors shall be copper, soft drawn, and annealed of 98 percent conductivity. Conductors larger than #10 AWG shall be stranded; #10 AWG and smaller shall be solid. Conductors shall be insulated for 600 volts and be of following types:

1. All conductors shall have heat/moisture resistant thermoplastic insulation type THHN/THWN (75 deg. C) except as follows:

   a. In sizes #1 AWG and larger: Crosslinked polyethylene insulation type XHHW (75 deg. C – 90 deg. C) may be used.

   b. Fire alarm system conductors shall be #14 AWG, type THHN, solid. Color coding of fire alarm conductors shall be in accordance with fire codes.

   c. Fixture whips #16AWG type "SF".

E. Stranded conductors for all wiring systems except fire alarm will be allowed if installed and terminated as specified under Execution Section.

F. Type MC Cable may be used for concealed branch circuits in hollow spaces where allowed by code if installed and terminated as specified under Execution Section. Armor shall be galvanized steel and shall be UL listed for 2 hour fire wall penetration. Light steel armor is acceptable.

G. Type MC Cable may be used for fire alarm where concealed and allowed by Code, armor shall be red.

H. Acceptable manufacturers:

1. AFC Cable Systems
2. American Wire & Cable
3. Cerro
4. Cornish
5. Cresent
6. General Cable
7. Okonite
8. Or equal.

2.04 ACCESS PANELS

A. Provide access panels for access to concealed junction boxes and to other concealed parts of system that require accessibility for operation and maintenance. In general, electrical work shall be laid out so access panels are not required.

B. Access panels shall be located in a workmanlike manner in closets, storage rooms, and/or other non-public areas, positioned so that junction can be easily reached and size shall be sufficient for purpose (minimum size 12 in. x 12 in.). When access panels are required in corridors, lobbies, or other habitable areas, they shall

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be located as directed.

C. Access panels shall be prime painted and equipped with screwdriver operated cam locks.

1. Acceptable manufacturers:
2. Inland Steel Products Company - Milcor
3. Miami Carey
4. Walsh-Hannon-Gladwin, Inc. - Way Locator
5. Or equal
6. Specific types:

a.	Acoustical Tile Ceiling	"Milcor Type AT"
b.	Plastered Surfaces	"Milcor Type K"
c.	Masonry Construction	"Milcor Type M"
d.	Drywall Construction	"Milcor Type DW"

D. Furnish access panel shop drawings.

2.05 SLEEVES, INSERTS AND OPENINGS

A. Sleeves: Provide sleeves of proper sizes for all openings required in concrete floors and walls. Sleeves passing through floors shall be set with top of sleeve 1in. above finished floor. Core drilling will also be acceptable if in accordance with any structural standards. Any unsleeved openings shall be waterproofed.

B. Inserts: Provide inserts or other anchoring devices in concrete and masonry construction as required to support raceways and equipment.

C. Openings: Where an opening is required in concrete slabs to allow passage of a multitude of raceways, give adequate notice to General Contractor so he may box out opening in form work.

D. Sleeves or openings through slabs for passage of future cables shall be located within 6 inches of walls and shall be in a single row and shall be proofed whether used or not.

E. Any openings through fire rated surfaces shall be closed off with fireproofing materials providing the same rating as the surface penetrated.

F. Acceptable Manufacturers:

1. Specified Technologies Inc.
2. Thomas & Betts
3. International Protective Coatings Corp.
4. 3M Fire Protection Products
5. Dow Corning

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6. Or equal

2.06 WIRING DEVICES

A. Receptacles: Receptacles shall be flush mounted. All standard 20 ampere devices to be of same manufacturer.

1. Acceptable Manufacturers:

Twenty (20) ampere duplex grounding type NEMA 5-20R, provide tamper resistant receptacles where shown on drawings.

Cooper 5362-V

Hubbell 5362I

Pass and Seymour 5362I

Leviton 5362I

Or equal

B. Switches: 20 ampere,

Cooper CWD 2221,

General Electric 5951,

Hubbell 1221,

Pass and Seymour 20AC-2,

Leviton 1221.

Or equal

Prewired devices with pigtails acceptable

C. Composition material of wiring devices to be nylon with ivory finish.

D. Coverplates: Finish shall be 302 stainless steel.

Provide gaskets on all wiring device plates where devices are on walls separating conditioned and non-conditioned spaces.

2.07 LIGHTING FIXTURES

A. Provide lighting fixtures complete with lamps, ballasts, and other devices as required for a first class installation. Furnish Ceiling Subcontractor with instructions concerning openings necessary, and provide frames for NEMA standard ceiling types or special mounting frames, as may be required. Fixtures shall be supported independently of hung ceiling construction.

B. LED Assemblies

1. LED luminaires shall conform to UL 1598 and to UL 8250 – Safety Standard for Light-Emitting Diode (LED) Light Sources for Use in Lighting Products.

2. Products shall be lead and mercury free.

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3. Photometric characteristics shall be established using IESNA LM-79-08, IESNA Approved Method for the Electrical and Photometric Measurement of Solid-State Lighting Products.

4. Color characteristics of LED luminaires shall be as follows in accordance with ANSI C78.377 – Specifications for the Chromaticity of Solid State Lighting Products.

5. LED and driver cooling system shall be passive and shall resist the buildup of debris.

6. LED luminaire output after 50,000 hours of operation shall be not less than 70 percent of the initial lumen output when determined in accordance with IESNA LM-80-08 – IESNA approved Method for Measuring Lumen Maintenance of LED Lighting Sources.

7. LED source package electrical characteristics:

   a. Supply voltage: 120 V, 208 V, 240 V, 277 V, or 480 V as indicated on the Drawings. Provide step-down transformers if required to match driver input voltage rating.

   b. Total harmonic distortion (current): Not more than 10 percent

   c. Power factor: Not less than 90 precent

   d. RF interference: Meet FCC 47 CFR Part 15/18

   e. Transient protection: IEEE C62.41 Class A.

8. All LED Assemblies shall be provided by Osram, Phillips, GE, or equal.

C. Fixture types shall be as scheduled. The note on fixture schedule "Possibly Acceptable Alternate Manufacturers" means that the manufacturers listed have products which could be equal. The determination of "equal" will be determined based upon features of the product specified by catalog number. Fixtures specially manufactured for this particular project and not part of a manufacturers standard line will not be acceptable.

2.08 ELECTRICAL POWER EQUIPMENT

A. Disconnect Switches:

1. Disconnect (safety) switches shall conform to industrial standards of NEMA, be UL listed and shall be heavy duty type, quick-make, quick-break type with interlocking cover mechanism and provisions for padlocking switch handle in "OFF" position. Three pole toggle switches are not acceptable as substitute for disconnect switches.

2. Disconnect switches shall be of fused or unfused type as indicated with number of disconnecting poles indicated. The grounded conductor shall not be switched. Switches for use with current limiting fuses shall be rejection type and those used in conjunction with motors shall be horsepower rated. Provide oversize termination lugs if required by

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conductor size.

3. Enclosures shall be of proper NEMA type for intended location and shall be phosphate coated or equivalent code gauge galvanized sheet steel with ANSI #24 dark gray baked enamel finish.

4. Acceptable Manufacturers:

   a. Westinghouse

   b. Square D/Groupe Schneider

   c. Siemens

   d. General Electric

   e. Or equal

B. Fuses:

1. Provide a complete set of fuses for each item of fusible type equipment. Fusible equipment furnished by other contractors will be complete with fuses, unless noted otherwise on electrical drawings. Each fuse initially installed shall be provided with Bussmann SAMI-indicating fuse covers.

2. Turn over to authorized representative of Owner upon completion a spare set of fuses of each different type and ampere rating installed. These spares shall be bound with twine and tagged.

3. Secondary system fuses, rated at 600 volts or less, shall be UL listed and constructed in conformance with the applicable standards set forth by NEMA and ANSI. All fuses of a particular class shall be of same manufacturer.

4. All fuses in distribution panelboards and switchboards shall be class "L" above 600 amperes and class "RK1" for 600 amperes and below.

5. Main, Feeder, and Branch Circuits:

6. Circuits 601 amperes and above shall be protected by (Bussmann type KRP-C LOW-PEAK) current limiting time delay fuses.

7. Circuits 0-600 amperes shall be protected by (Bussmann "LOW-PEAK" dual element), KPS-RK (600 volts), UL class RK-1.

8. Acceptable Manufacturers:

   a. Bussmann, Division of McGraw

   b. Gould/Shawmut

   c. GEC-ALSTHOM

   d. Or equal

2.09 ELECTRICAL SYSTEM CONTROLS AND INSTRUMENTS

A. Provide a complete power system consisting of branch circuits, motor disconnect

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switches, pushbutton stations, motor starters, and other devices to connect up and leave in operating condition each piece of electrically operated equipment provided either under this section or other Divisions.

B. The Electrical Subcontractor is to provide a 120 volt source with a disconnect switch at one location next to the main automatic temperature control panel.

C. All control wiring not indicated in the electrical specifications or not shown on electrical drawings will be provided by Temperature Control Subcontractor.

2.10 GROUNDING SYSTEM

A. All equipment and systems shall be grounded. Refer especially to NEC Section 250 Requiring Connections to Building Steel, Foundation, Water Service, and Interior Piping. Provide transformer pad grounding to be in accordance with local utility company standards.

B. The grounded conductor shall be supplemented by an equipment grounding system.

C. The equipment grounding system shall be installed so all conductive items in close proximity to electrical circuits operate continuously at ground potential and provide a low impedance path for ground fault currents.

D. Grounding conductors shall be so installed as to permit shortest and most direct path to ground.

E. Maximum measured resistance to ground of 5.0 ohms shall not be exceeded. Ground separately derived systems (dry type transformers) in accordance with Article 250 by grounding neutral to transformer ground lug and providing insulated grounding electrode conductor to nearest effectively grounded building steel or, if unavailable, to nearest available effectively grounded metal water pipe.

F. Equipment grounding conductors and straps shall be sized in compliance with Code Table 250-122.

G. Grounding conductors shall be insulated with green color. Grounding conductors for use on isolated ground receptacles shall be green with trace color to differentiate between normal ground conductors.

H. Branch circuits shall consist of phase and grounded conductor installed in common metallic raceway. The raceway system may not serve as the grounding conductor. All circuits shall have a separate insulated grounding conductor installed. Any flexible cable system or non-metallic raceway system shall have an insulated grounding conductor. Any cable system for use on isolated ground circuits shall have both an isolated ground conductor as well as an equipment ground conductor, both of which shall be insulated.

I. Each electrical expansion fitting shall be furnished with a bonding jumper.

J. Provide grounding bushings and ground connections for all raceways terminating below equipment where there is no metal-to-metal continuity.

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K. Continuity between all metallic and non-metallic raceway systems and equipment shall be maintained.

L. Outdoor lighting fixtures shall be grounded and bonded in common with building system via a separate grounding conductor.

2.11 FIRE ALARM AND DETECTION SYSTEM (EXTENSION OF EXISTING)

A. Scope:

1. Provide extension of existing fire alarm system as required and indicated on drawings. Provide all necessary power supplies, relays and addressable cards for work indicated on drawings.

2. Basic System Functional Operation:

3. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

a. The FACP alarm LED on the FACP shall flash.

b. A local piezo-electric signal in the FACP control panel shall sound.

c. The 80-character LCD display on the local FACP node and on the intelligent network display shall indicate all information associated with the fire alarm condition, including the type of alarm point, and its location within the protected premises.

d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.

e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

f. Program system to reflect new devices.

g. Test system so that alarm transmits to campus police and fire department simultaneously.

4. Software Modifications:

a. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes.

b. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm network on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place

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no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

c. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer and trained on network applications. Include names and addresses in the certification.

B. Applicable Publications:

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

1. National Fire Protection Association (NFPA) - USA:

No. 72	National Fire Alarm Code
No. 70	National Electric Code
No. 101	Life Safety Code

2. Underwriters Laboratories Inc. (UL) - USA:

No. 50	Cabinets and Boxes
No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 228	Door Closers-Holders for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1481	Power supplies for Fire Protective Signaling Systems

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No. 1076 Control Units for Burglar Alarm
Proprietary Protective Signaling Systems

No. 1971 Visual Notification Appliances

3. Local and State Building Codes:

4. All requirements of the Authority Having Jurisdiction (AHJ).

C. Approvals:

1. The system must have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories Inc.
FM	Factory Mutual
MEA	Material Equipment Acceptance (NYC)
CSFM	California State Fire Marshal

D. Conduit and Wire:

1. Conduit:

a. Conduit shall be in accordance with the National Electrical Code (NEC), local and state requirements.

b. Where exposed, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

c. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.

d. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

e. Conduit shall not enter any FACP, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

f. Conduit shall be 3/4 inch (19.1 mm) minimum.

g. MC Fire Alarm Control Cable with red armor may be used for fire alarm where concealed and allowed by code.

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2. Wire:

   a. All fire alarm system wiring must be new, unless specified herein.

   b. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 16 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.32 mm) for notification appliance circuits.

   c. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

   d. Wiring used for the SLC multiplex communication loop shall be twisted and shielded unless specifically accepted by the fire alarm equipment manufacturer.

   e. All field wiring shall be completely supervised.

3. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. Intelligent Photoelectric Smoke Detector:

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Smoke detector shall be compatible with existing FACP model #4098-9714 with #4098-9792 base.

F. Two Wire Detector Monitor Module:

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).

2. The two-wire monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box or with an optional surface backbox.

3. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

G. Addressable Control Module:

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a

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dry contract relay.

2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.

3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

4. Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply.

5. The control module shall be suitable for pilot duty applications and rated for a minimum of .6 amps at 30 VDC.

H. Isolator Module:

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. At least one isolator module shall be provided for each floor or protected zone of the building.

2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

4. The isolator module shall mount in a standard 4-inch deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

I. Batteries and External Charger:

1. Battery:

a. Batteries shall be 12 volt, Gell-Cell type.

b. The battery shall have sufficient capacity to power the fire alarm system for not less than 60 hours plus 10 minutes of alarm upon a normal AC power failure.

c. The batteries are to be completely maintenance free. No liquids are

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required. Fluid level checks for refilling, spills and leakage shall not be required.

J. Field Quality Control

1. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
2. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
   a. Factory trained and certified.
   b. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
   c. International Municipal Signal Association (IMSA) fire alarm certified.
   d. Certified by a state or local authority.
   e. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
3. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
4. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
5. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.
6. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
7. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.
8. Final Test, Certificate of Completion, and Certificate of Occupancy:
   a. Test the entire system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.
9. Provide 2 hours of Owner training.

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2.12 SEALS

A. Water Tight Seals

1. Conduits entering from the exterior or below grade shall have water tight fittings on the outside and on the inside of the conduit.

a. Fittings on the outside of the conduit shall be O-Z Gedney type FSK or approved equal. Provide type WSK if penetration is within two feet of the high water table. Provide grounding attachment.

b. Fittings on the inside of the conduit shall be O-Z Gedney type CSBI or approved equal. Provide type CSBG if penetration is within two feet of the high water table. Provide a blank fitting to seal spare or empty conduits.

c. O-Z Gedney type CSM fitting may be used when sealing within a sleeve or cored hole.

2. Submit on seals to be used.

B. Environmental Seals

1. Provide seals on raceways exposed to widely different temperatures, as in refrigerating or cold storage areas. Install seal to prevent circulation of air from warmer to colder sections through the raceway.

C. Hazardous Area Seals

1. Provide explosion proof seals as required by the Electric Code.

a. NONE.

D. Smoke and Fire Stopping Seals

1. Provide a seal around raceways or cables penetrating full height walls (slab to slab), floors or ventilation or air handling ducts so that the spread of fire or products of combustion shall not be substantially increased.

2. Penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be firestopped using approved methods and NRTL listed products to maintain the fire resistance rating.

3. Fire stopping in sleeves or in areas that may require the addition or modification of installed cables or raceways shall be a soft, pliable, non-hardening fire stop putty. Putty shall be water resistant and intumescent. Provide for all sleeves and raceways.

4. Firestopping in locations not likely to require frequent modification shall be NRTL listed putty, caulk or mortar to meet the required fire resistant rating.

5. Box penetrations into a fire rated wall or shaft shall have a fire stopping pad installed on the back of the box.

6. Firestopping of cable trays or busways through walls shall be within a

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non-hardening putty or with seal bags.

7. Firestopping materials shall be NRTL listed to UL 1479 (ASTM E814). Installation methods shall conform to a UL firestopping system. Submit specifications and installation drawings for the type of material to be used. Firestopping materials shall be as manufactured by 3M, International Protective Coatings Corp., RayChem or approved equal.

2.13 FLOOR OUTLETS (FLUSH TYPE)

A. Section includes flush floor boxes equal to Wiremold RFB Series. Provide appropriate floor box model that meets the intent of what is shown on the drawings.

B. Quality Assurance

1. Electrical Raceways and Components: Comply with requirements of applicable local codes, NEC, UL, and NEMA Standards pertaining to raceways and components. Listed and labeled in accordance with NFPA 70, Article 100.

C. Floor Boxes

1. RFB4 and RFB4-4DB Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 12-3/4" L x 10" W x 3-7/16" H [324mm x 254mm x 87mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The RFB4 Series Box shall permit tunneling from end power compartment to end power compartment. The RFB4-4DB Series Box shall permit tunneling from adjacent or opposite compartments. Two (2) of the four (4) compartments shall have a minimum wiring capacity of 16.4 cu in [269cu cm], one (1) compartment shall have a minimum capacity of 32.3 cu in [529cu cm], and one (1) compartment shall have a minimum capacity of 50 cu in [820cu cm]. Four (4) compartments shall have a minimum of two (2) inches of space behind the device plates. The box shall include the following number of conduit knockouts: one (1) 1/2-inch [12.7mm], three (3) 1-inch [25mm], six (6) 3/4-inch [19.1mm], and six (6) 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-7/8-inch [47.7mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics® workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

2. RFB4-CI-1 and RFB4-CI-NA Series Floor Boxes: Manufactured from cast-iron and approved for use on grade and above grade floors. The box shall be 14-1/2" L x 11-7/8" W x 3-7/16" H [368mm x 302mm x 87mm]. Provide the box with four (4) independent wiring compartments that allow

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capacity for up to four (4) duplex receptacles and/or communication services. The box shall permit tunneling from adjacent or opposite compartments. Two (2) of the four (4) compartments shall have a minimum wiring capacity of 27 cu in [443cu cm], and two (2) compartments shall have a minimum wiring capacity of 36 cu in [590cu cm]. Four (4) compartments shall have a minimum of two (2) inches of space behind the device plates. The box shall include the following number of conduit hubs: four (4) 1-inch [25mm] and four (4) 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-7/8-inch [48mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics® workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

3. RFB4-SS Series Floor Boxes: Manufactured from stamped-steel and approved for use on above grade floors. The box shall be 13-5/8" L x 10" W x 2-7/16" H [346mm x 254mm x 62mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the four (4) compartments shall have a minimum wiring capacity of 15.7 cu in [257cu cm] and two (2) compartments shall have a minimum wiring capacity of 31.2 cu in [511cu cm]. Four (4) compartments shall have a minimum of two (2) inches of space behind the device plates. The box shall contain the following number of conduit knockouts: two (2) 1/2-inch [12.7mm], six (6) 3/4-inch [19.1mm], and eight (8) 1-inch [25mm]. The box shall be fully adjustable, providing a maximum of 1-7/8-inch [48mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics® workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

4. RFB4E Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 13-1/8" L x 13-1/8" W x 4-1/16”" H [333mm x 333mm x 103mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The box shall permit feed through removable barriers from adjacent compartments. Four (4) compartments shall have a minimum wiring capacity of 75 cu in [1230cu cm]. Four (4) compartments shall have a minimum of 3-1/2 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: six 3/4-inch [19.1mm], ten (10) 1-inch [25mm], and eight (8) 1-1/4-inch [32mm]. The

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box shall have two removable knockout plates that can be replaced with a 2-inch trade size conduit hub (2HUB). The box shall be fully adjustable, providing a maximum of 2-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

5. RFB4E-OG Series Floor Boxes: Manufactured from stamped steel and painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and approved for use on grade and above grade floors. The box shall be 13-1/8" L x 13-1/8" W x 4-1/16" H [333mm x 333mm x 103mm]. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles, communication and/or audio/video services. The box shall permit feed through removable barriers from adjacent compartments. Four (4) compartments shall have a minimum wiring capacity of 75 cu in [1230cu cm]. Four (4) compartments shall have a minimum of 3-1/2 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: six 3/4-inch [19.1mm], ten (10) 1-inch [25mm], and eight (8) 1-1/4-inch [32mm]. The box shall have two removable knockout plates that can be replaced with a 2-inch trade size conduit hub (2HUB). The box shall be fully adjustable, providing a maximum of 2-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

6. RFB6 Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 3-1/4" H [333mm x 317mm x 83mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a

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maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

7. RFB6-OG Series Floor Boxes: Manufactured from stamped steel and painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and approved for use on grade and above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 3-1/4" H [333mm x 317mm x 83mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment.

8. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

9. RFB6E Series Floor Boxes: Manufactured from stamped steel and approved for use on above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 4" H [333mm x 317mm x 102mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments through 1-1/4-inch grommet openings. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a maximum of

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3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

10. RFB6E-OG Series Floor Boxes: Manufactured from stamped steel and painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and approved for use on grade and above grade floors. The box shall be 13-1/8" L x 12-1/2" W x 4" H [333mm x 317mm x 102mm]. Provide the box with six (6) independent wiring compartments that allow capacity for up to six (6) duplex receptacles, communication and/or audio/video services. The box shall permit feed through tunneling from adjacent compartments. Two (2) of the six (6) compartments shall have a minimum wiring capacity of 23 cu in [376cu cm] and four (4) compartments shall have a minimum wiring capacity of 52cu in [850cu cm]. Four (4) of the six (6) compartments shall have a minimum of 3-1/4 inches of space behind the device plates, and two (2) of the six (6) compartments shall have a minimum of 2-3/8 inches of space behind the device plates. The box shall contain the following number of conduit knockouts: twelve 3/4-inch [19.1mm], four (4) 1-inch [25mm], and twelve 1-1/4-inch [32mm]. The box shall be fully adjustable, providing a maximum of 1-3/8-inch [35mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices.

D. Activation Covers

1. FloorPort FPCT, FPBT, and FPFFT Series Covers: Manufactured of die-cast aluminum or die-cast zinc, and available in brushed aluminum finish and powder-coated paint finishes (black, gray, bronze, nickel and brass). Activation covers shall be available in flanged and flangeless versions. Covers shall be available with options for tile or carpet inserts, or flush covers. The cover's hinge shall allow for the cover to open 180 degrees. The furniture feed covers shall come equipped with one (1) 1-inch trade size screw plug opening and one (1) combination 1-1/4-inch and 2-inch trade size screw plug.

   a. Flanged covers shall be 7-3/4" L x 6-9/16" W [197mm x 167mm].

   b. Flangeless covers shall be 6-3/4" L x 5-9/16" W [171mm x 142mm].

2. 6CT, 6CTC, 6CFFTC, 8CTC, and 8CT Series Covers: Manufactured of die-cast aluminum alloy and available in powder-coated gray, black, brass,

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nickel or bronze finish. The covers shall be available in carpet and tile versions. Provide covers with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub water tightness. The activation cover for the 8CTC and 8CT series shall be 9-1/4-inch [235mm] in diameter. The activation cover for the 6CT and 6CTC series shall be 7-1/4-inch [184mm] in diameter and the activation cover for the 6CFFTC series shall be 7-3/4-inch [197mm] in diameter. The carpet covers shall be surface mounted and the tile covers shall be flush with the finished floor covering. The covers shall have spring loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.

3. The covers shall have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors.

E. Communication Modules Mounting Accessories

1. The floor box manufacturer shall provide a complete line of faceplates and bezels to facilitate mounting of UTP, STP (150 ohm), fiber optic, coaxial, and communication devices. The box shall provide a series of device mounting plates that will accommodate Ortronics workstation connectivity outlets and modular adapters, and other open system devices.

F. Installation

1. Strictly comply with manufacturer's installation instructions and recommendations and approved shop drawings. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.

2. Mechanical Security: Raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, device mounting brackets, and cabinets, in accordance with manufacturer’s installation sheets.

3. Accessories: Provide accessories as required for a complete installation, including insulated bushings and inserts where required by manufacturer.

4. Unused Openings: Close unused box openings using manufacturer's recommended accessories.

5. Provide a minimum concrete pour depth of 3-7/16-inch [87mm] plus 1/16-inch [1.6mm] above the top of the box for the RFB4, RFB4-4DB, RFB2, and the RFB2-OG Series Boxes; 2-7/16-inch [62mm] plus 1/16-inch [1.6mm] for the RFB4-SS and RFB2-SS Series Boxes; and 3-7/16-inch [87mm] plus 13/16-inch [21mm] above the top of the box for the RFB4-CI-1, RFB6, and RFB6-OG Series Boxes; and 4-1/16-inch [103mm] above the top of the RFB4E and RFB4E-OG Series Boxes; and 4-inch [102mm] above the top of the RFB6E and RFB6E-OG Series Boxes. Provide the box with four (4) locations to accommodate leveling for pre-concrete pour adjustment and include four (4) leveling screws for the pre-

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pour adjustment.

6. Cleaning and Protection

7. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.

8. Protect boxes and fittings until acceptance.

2.14 LIGHTNING PROTECTION SYSTEM

A. General:

1. Provide all labor, material, equipment, and services required for the complete lightning protection system in accordance with NFPA 780, UL96A and applicable contract drawings for the Building. System shall receive UL Master Label. This section is responsible for providing a design for an approved "UL Master Label System" in accordance with the drawings and specifications.

B. The following items of work are specifically included in, but not necessarily limited to the work of this section without limiting the generality implied by the Specifications.

1. Air terminals.

2. Copper cable roof conductors.

3. Down conductor.

4. Ground grid installation.

C. Manufacturer shall provide seven complete sets of shop drawings for review, showing location of air terminals, conductors, installation procedures and details, and detailed manufacturer's data sheets on all components, accessories, and miscellaneous equipment to be used in this installation.

D. Description of System:

1. The contractor shall provide a complete installation of equipment to comprise a system for protection against damage by lightning.

2. The system, including air terminals, conductors, and complementary parts, shall be installed so that completed work is unobtrusive and does not detract from the building appearance.

3. The work shall comply with all applicable federal, state, municipal laws, ordinances, and regulations.

E. Standards of Quality:

1. All materials shall be the product of a manufacturer regularly engaged in the production of lightning protection equipment.

2. All material shall be manufactured by Thompson Lightning Protection,

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Harger, East Coast Lightning Equipment, Heary Bros. or equal.

F. Service, Testing and Guarantee:

1. Installation of equipment shall be done under direct supervision of the equipment manufacturer's factory representative. A master labeled system is to be provided.
2. The completed lightning protection systems shall be fully tested in the presence of the Architect to demonstrate continuity of all conductors. A written test report shall be submitted.
3. The ground grid resistance shall be measured and a written statement submitted to the architect. Grid resistance shall be 5 ohms or less.

G. Products:

1. Air Terminals:

a. Complete assembly consisting of chrome plated air terminal with attachment mechanisms.

2. Conductors:

b. Copper conductors shall be 28 strands of #13 gauge, net weight 420 pounds per 1000 ft., minimum.

3. Ground Rods:

c. Ground rods shall be copperweld, ¾ in. minimum diameter, 10 feet minimum length.

4. Connectors, Fitting, Fasteners and Hardware:

d. Provide all connectors, fittings, fasteners, hardware, clamps, guards, lugs, etc., as required to connect, interconnect and install all parts of the system.

e. All shall be fabricated from copper metal and be approved for use intended.

f. All connections between dissimilar metals shall have connectors approved for this type of application.

H. Installation:

1. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.
2. All work installed within the building shall be concealed.
3. All work installed in accessible locations shall be properly guarded and protected.
4. All material shall be installed in a manner to prevent electrolyic action under the presence of moisture.
5. All roof, wall or other building penetrations shall be made in a manner to prevent the ingress of water or moisture. Roof penetrations shall be

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furnished and installed by Roofing Contractor.

6. PVC sleeves shall be provided where conductors pass through all floors.

7. Installation shall be accomplished in a manner to eliminate possibility of displacement and subsequent maintenance.

8. All connections shall be mechanically and electrically sound and all bonding surfaces shall be cleaned and brightened just prior to attachment.

9. All excavating, backfilling and tamping earthwork as required by General Trades Contractor.

10. Install down conductors concealed within wall.

11. Cables on flat roof areas may be run exposed. Adhesive type fasteners shall be spaced at 3 ft. – 0 in. maximum. Adhesive used shall be compatible with roofing materials. Coordinate with approved shop drawings.

12. Ground rods shall be driven to full depth in soil undisturbed by building excavation and are not to be driven into excavation backfill area.

13. Provide connection between grid and water service.

14. Provide grid resistance of 5 ohms maximum.

15. Top of ground rods shall be installed at least 2 ft. – 0 in. below finished grade.

I. Master Label:

1. Submit factory certified tests.

2. Submit guarantee for installation and range of lightning protection.

PART 3 EXECUTION

3.01 WORK COORDINATION AND JOB OPERATIONS

A. Equipment shall not be installed in congested and possible problem areas without first coordinating installation of same with other trades. Relocate electrical equipment installed in congested or problem areas should it interfere with the proper installation of equipment to be installed by other trades.

B. Particular attention shall be directed to coordination of lighting fixtures and other electrically operated equipment requiring access which is to be installed in ceiling areas. Coordinate with other trades, the elevations of equipment in hung ceiling areas to insure adequate space for installation of recessed fixtures before said equipment is installed. Conflicts in mounting heights and clearances above hung ceilings for installation of recessed lighting fixtures or other electrically operated equipment requiring access shall be brought to the attention of Architect for a decision prior to equipment installation.

C. Furnish to General Contractor and other subcontractors information relative to portions of electrical installation that will affect other trades sufficiently in

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advance so that they may plan their work and installation.

D. Obtain from other trades information relative to electrical work which he, the Electrical Subcontractor, is to execute in conjunction with installation of other trades' equipment.

E. Lighting fixtures in mechanical spaces or utility/ storage rooms shall only be installed after all mechanical equipment is in place.

3.02 PLANS AND SPECIFICATIONS

A. Plans

1. Drawings showing layout of electrical systems indicate approximate location of raceways, outlets and apparatus. Runs of feeders and branch circuits are schematic and are not intended to show exact routing. Final determination as to routing shall be governed by structural conditions and other obstructions.

B. Specifications

1. Specifications supplement drawings and provide specifics pertaining to methods and material to be used.

3.03 IDENTIFICATION

A. Equipment shall be marked for ease of identification as follows.

1. Provide screw-on nameplates on switchboards, panelboards, F.A. terminal cabinets, starters, and disconnect switches. Nameplates to be of black phenolic with white engraving. For starters and disconnect switches lettering shall be minimum of 1/4 in. high. Nameplates on panelboards shall have the following information.

a. Line 1 - Panel designation in 1/2 in. high letters.

b. Line 2 - Utilization voltage in 3/8 in. high letters.

c. Line 3 - Distribution source "Fed from " in 1/4 in. high letters.

2. Neatly typed directory cards listing circuit designations shall be fastened inside the cover of panelboards. Spare circuits shall be penciled.

3. Color coding schedules. If there is more than a single system voltage, different voltages shall have secondary switchboard and distribution panel and shall be of the phenolic nameplate type as previously specified. A typewritten color code schedule shall also be affixed, under plastic, inside each panelboard door.

4. Outlet boxes both concealed and exposed shall be identified as to panel origination and circuit number by means of fibre pen on the inside of coverplate.

5. Special system outlet boxes concealed above hung ceilings shall be identified as to system by spray painting during roughing. The following

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systems shall be identified.

a. Fire Alarm - red.

b. Emergency - yellow.

c. Sound – green

6. Wiring device plates on devices connected to normal-emergency circuits shall be red in color.

7. All conductors in boxes larger than standard outlet boxes, in all wireways, trench headers, etc. shall be grouped logically and be identified.

8. Grounding conductors and neutrals shall be labeled in panels, wireways, etc. as to circuits associated with.

3.04 PROTECTION AND CLEANUP

A. Protection:

1. Materials and equipment shall be suitably stored and protected from weather.

2. During progress of work, pipe and equipment openings shall be temporarily closed so as to prevent obstruction and damage.

3. Be responsible for maintenance and protection of material and equipment until final acceptance.

B. Cleanup:

1. Keep job site free from accumulation of waste material and rubbish. Remove all rubbish, construction equipment, and surplus materials from site and leave premises in a clean condition.

2. At completion, equipment with factory finished surfaces shall be cleaned and damaged spots touched up with the same type paint applied at factory.

3. Particular attention is called to Section 110-12(c) of the NEC, which requires that internal parts of electrical equipment not be contaminated by construction operations.

3.05 PORTABLE OR DETACHABLE PARTS

A. Retain possession of and be responsible for spare parts, portable and detachable parts, and other removable portions of installation including fuses, keys, locks, blocking clips, inserts, lamps, instructions, drawings, and other devices or materials that are relative to and necessary for proper operation and maintenance of the system until final acceptance, at which time such parts shall be installed or turned over to the Owner, as the case may be.

3.06 SAFETY PRECAUTIONS

A. Provide proper guards, signage, and other necessary construction required for prevention of accidents and to insure safety of life and property. Remove any

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temporary safety precautions at completion.

3.07 MOUNTING HEIGHTS

A. All electrical equipment shall be mounted at the following heights unless noted or detailed otherwise on drawings. Notes on architectural drawings shall supersede those noted below or detailed on the electrical drawings. If mounting height of an electrical component is questionable, obtain clarification from Architect before installation.

1. Duplex convenience outlets, microphone outlets, and telephone outlets - 18 inches.

2. Light switches, pushbutton stations, HOA switches, and all other toggle or control switches for the operation of heating, ventilating, and air conditioning, plumbing, and general service - 48 inches.

3. Fire alarm pull stations - 48 inches.

4. Fire alarm audio visual signals - 80 inches or 6 inches below ceiling, whichever is lower.

5. Panelboards for lighting, power, telephone, and other auxiliary systems - 78" to top.

6. Equipment located in lobbies shall be located as detailed on architectural drawings or as directed by Architect.

7. All receptacles, light switches, and fire alarm signals sharing a common location shall be symmetrically arranged.

8. Exterior and interior wall brackets shall be as detailed on architectural drawings or as directed by Architect.

B. Mounting heights given are from finished floor to centerline. In the case of a raised floor, surface of raised floor is the finished floor.

3.08 WORKMANSHIP AND INSTALLATION METHODS

A. Work shall be installed in first-class manner consistent with best current trade practices. Equipment shall be securely installed plumb and/or level. Flush-mounted outlet boxes shall have front edge flush with finished wall surface. No electrical equipment shall be supported by work of other trades. Cable systems shall be supported and not draped over ducts and piping or laid on ceiling suspension members. Lighting fixtures shall be installed to agree with Architects reflected ceiling plans.

B. Supports

1. Support work in accordance with best industry practice and by use of standard fittings.

2. In general, walls and partitions will not be suitable for supporting weight of panelboards, and the like. Provide supporting frames or racks extending from floor slab to structure above.

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3. Provide supporting frames or racks for equipment, intended for vertical surface mounting in free standing position where no walls exist.

4. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of equipment.

5. General Contractor to provide 3/4 in. thick painted plywood mounting surfaces in all electric and telephone areas and for all equipment on freestanding racks. All plywood shall be fire retardant and painted both sides and edges with 2 coats of white paint.

6. No work for exposed installations in damp locations shall be mounted directly on any building surface. In such locations, flat bar members or spacers shall be used to create a minimum of 1/4 in. air space between building surfaces and work.

7. Nothing (including outlet, pull and junction boxes and fittings) shall depend on electric raceways or cables for support. All outlet, pull, and junction boxes shall be independently supported.

8. Nothing shall rest on, or depend for support on, suspended ceiling or its mounting members.

9. Support surface or pendant mounted lighting fixtures:

   a. From outlet box by means of an interposed metal strap, where weight is less than five pounds.

   b. From outlet box by means of a hickey or other direct threaded connection, where weight is from five to fifty pounds.

   c. Directly from structural slab, deck or framing member, where weight exceeds fifty pounds.

   d. Pendant lighting fixtures shall be supported by threaded rods in non-public areas and by manufacturer's standard tube hangers with swivel aligner and canopy in public areas. Provide non-standard pendant lengths where required to mount fixtures at elevations either called for on drawings or as shown in architectural elevations.

10. Support recessed lighting fixtures directly from structural slabs, decks or framing members, by means of jack chain or air craft cable, one at each end of fixture at opposite corners.

11. Where support members must of necessity penetrate air ducts, provide airtight sealing provisions which allow for a relative movement between the support members and the duct walls.

12. Provide channel sills or skids for leveling and support of all floor mounted electrical equipment.

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13. Where permitted loading is exceeded by direct application of electrical equipment to a slab or deck, provide proper dunnage as required to distribute the weight in a safe manner.

14. Support metallic raceways by either running within steel frame or hung from the building frame. Anything hung from building frame shall be attached with metallic fasteners.

C. Fastenings

1. Fasten electric work to building structure in accordance with the best industry practice.

2. Where weight applied to attachment points is 100 pounds or less, fasten to building elements of:

   a. Wood -- with wood screws.

   b. Concrete and solid masonry -- with bolts and expansion shields.

   c. Hollow construction -- with toggle bolts.

   d. Solid metal -- with machine screws in tapped holes or with welded studs.

3. Where weight applied to attachment points exceeds 100 pounds, fasten as follows:

   a. At field poured concrete slabs, provide inserts with 18 in. minimum length slip-through steel rods, set transverse to reinforcing steel.

   b. Where building is steel framed, utilize suitable auxiliary channel or angle iron bridging between structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.

4. Floor mounted equipment shall not be held in place solely by its own dead weight. Provide floor anchor fastenings. Floor mounted equipment over 72 inches in height shall also be braced to nearest wall or overhead structural elements.

5. For items which are shown as being mounted at locations where fastenings to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging to building structural elements.

6. Fastenings for metallic raceways using the fastening as support shall be of the metallic type. Fastenings to hold raceways or cables in place may be via tyraps.

D. General Raceway Installation:

1. Install the various types of raceways in permitted locations as previously specified. All raceways shall be run concealed. Consult Architect for

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instruction for raceways which must be exposed in public spaces.

2. Raceways for normal-emergency or emergency only wiring cannot contain other conductors.

3. Raceways shall be properly aligned, grouped, and supported in accordance with code. Exposed raceways shall be installed at right angles to or parallel with structural members. Concealed raceways may take most direct route between outlets.

4. Raceways run on trapese hangers shall be secured to the trapese.

5. Raceways shall be continuous and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from service to all outlets. Provide grounding bushings and bonding jumpers where raceways attach to painted enclosures or terminate below equipment.

6. Where raceways enter boxes, cabinets, tap boxes, other than those having threaded hubs, a standard locknut shall be used on the outside and locknut and bushing on the inside.

7. Where raceways terminate below equipment and there is no direct metal to metal continuity, provide grounding bushings on raceways and interconnect with equipment grounding conductor.

8. All empty raceways shall be provided with a pull wire.

9. All raceway sleeves, stub-ups, or stub-outs, where not connected to a box or cabinet, shall be terminated with a bushing.

10. All raceway joints shall be made up tight and no running threads will be permitted.

11. Where raceways are cut, the inside edge shall be reamed smooth to prevent injury to conductors.

12. All vertical raceways passing through floor slabs shall be supported.

13. Raceways shall not be installed in concrete slabs above grade or below waterproofed slabs.

14. Electric raceways and/or sleeves passing through floors or walls shall be of such size and in such location as not to impair strength of construction. Where raceways alter structural strength or the installation is questionable, the structural engineer shall be contacted for approval.

15. Raceways shall not run directly above or below heat producing apparatus such as boilers, nor shall raceways run parallel within 6 inches of heated pipes. Raceways crossing heated pipes shall maintain at least a 1-inch space from them.

16. Raceways shall be installed in such a manner as to prevent collection of trapped condensates, and all runs shall be arranged to drain.

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17. Where two alternate wiring methods interconnect such as EMT to flexible metal conduit, an outlet box shall be provided.

18. All empty raceways entering building and all sleeves or core drilled openings through floors shall be sealed.

19. Each exterior raceway or assembly in a ductbank shall be provided with continuous warning tape installed 12 inches above raceway or ductbank.

20. Underground rigid non-metallic raceways where allowed and run as a ductbank encased in concrete shall be installed with plastic spacers to ensure a separation of 3 inches between raceways. Top of ductbanks shall be 30 inches below grade, unless otherwise detailed.

21. Elbows and extensions of rigid non-metallic raceway systems which penetrate slabs shall be rigid or intermediate metal conduit.

22. Raceways used for transformer connections shall be flexible type and shall contain a grounding conductor.

23. Raceways entering building through foundation wall into a basement area shall be provided with wall entrance seals or with other acceptable waterproofing method.

E. General Outlet Box Installation:

1. Boxes shall be set flush with finish surface and provided with proper type extension rings or plaster covers. Thru the wall boxes are not permitted. Check device or fixture to be mounted to box to ensure box orientation is proper.

2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operation.

3. Remove knockouts only as required and plug unused openings.

4. Where required for horizontal and vertical alignment of boxes in stud partitions, bar hangers spanning two studs shall be used. Device boxes for insertion type receptacles shall be provided with far side box supports where there are less than two entering nonflexible raceways, and where bar rangers are not provided.

5. Boxes flush mounted in fire rated partitions and on opposite sides of the partition shall be separated by a distance of 24 inches in accordance with UL listing for the box.

6. Locations of outlets indicated on drawings are approximate. For items exposed to view, refer to architectural drawings and coordinate locations with masonry joints, panel joints, ceiling grids, structural members, etc.

7. In case of conflict with standard mounting heights and device alignment, consult Architect prior to roughing.

8. Check all door swings on architectural drawings to ensure lighting

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switches are installed on strike side of door.

9. The right to make any reasonable change in location of outlets prior to roughing is reserved by Architect. "Reasonable change" shall be interpreted as movement within 10 feet of location shown.

10. Obtain dimensioned plan from Architect for floor outlets.

11. Outlet boxes for use where surface metal raceways are allowed shall be of a type specifically designed to be used with such surface metal raceway systems.

F. Conductor Installation:

1. No conductors shall be pulled into individual raceways until such raceway system is complete and free of debris. No harmful lubricants shall be used to ease pulling.

2. All conductors shall be wired so that grounded conductor is unbroken; switches in all cases being connected in ungrounded conductor.

3. Connections throughout the entire job shall be made with solderless type devices of approved design satisfactory to Inspector of Wires.

4. All taps and splices shall be insulated equal to that of conductor insulation.

5. All conductors of each feeder in pull boxes etc. shall be grouped, tied together, supported, and identified.

6. All conductors in panelboards and other wiring enclosures shall be neatly formed and grouped.

7. All conductors of emergency only shall be run in separate raceway systems to final outlet box.

8. Provide support for conductors in vertical raceways in accordance with Article 300-19.

9. Strip insulation from conductors with approved tools and only of sufficient length for proper termination. Cutting of conductor stranding is unacceptable.

10. Taps from paralleled conductors shall be of a type which tap each conductor, such as ILSCO "PTA" series.

11. Grounding conductors are to be identified as to associated power circuits.

G. Type MC Cable Installation:

1. Where cable is permitted under the products section, the installation of same shall be done in accordance with code and the following:

a. Cable shall be supported in accordance with code. Tie wire is not an acceptable means of support. Horizontally run cable supports such as Caddy WMX-6, and clamps on vertical runs such as Caddy CJ6 shall be used. Where cables are supported by the structure and

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only need securing in place, then ty-raps will also be acceptable. Ty-raps are not acceptable as a means of support. All fittings, hangers, and clamps for support and termination of cables shall be of types specifically designed for use with cable, i.e., romex connectors not acceptable.

b. Armor of cable shall be removed with rotary cutter device equal to roto-split by Seatek Co., not with hacksaw.

c. Use split "insuliner" sleeves at terminations.

d. Any cable system used in conjunction with isolated ground circuits shall have both an isolated ground conductor and an equipment ground conductor.

H. Stranded Conductor Installation:

1. If Contractor selects stranded conductors for # 10 AWG and smaller, terminate such conductors as follows:

a. No stranded conductor may be terminated under a screwhead. Provide insulated terminal lugs for all screw connections equal to Thomas & Betts "STA-KON" type RC with forked tongue and turned up toes. Installation of lugs shall be done with compression tool such as T&B WT-145C which prevents opening of tool until full compression action is completed.

b. Backwired wiring devices shall be of clamp type; screw tightened. Force fit connections not allowed.

2. Stranded conductors will not be allowed for fire alarm work.

I. Accessibility:

1. Electrical equipment requiring service or manual operation shall be accessible.

2. Work switches for equipment within accessible hung ceiling spaces, such as fan powered terminal boxes, shall be located at terminal box, and so located so as to be accessible.

J. Vibration Elimination:

1. All equipment connections to rotating equipment or equipment capable of vibration shall be made up by flexible raceways.

K. Wiring Device Gaskets:

1. Provide wiring device gaskets at coverplates where device is mounted in wall separating conditioned and non-conditioned spaces.

3.09 BRANCH CIRCUITS

A. Provide all branch circuit wiring and outlets for a complete and operating system. The system shall consist of insulated conductors connected to the panelboards and

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run in raceways or as cable systems if permitted under products section, as required to the final outlet and shall include outlet boxes, supports, fittings, receptacles, plates, fuses, etc.

B. Physical arrangement of branch circuit wiring shall correspond to circuit numbering on drawings. Combining of circuits and raceways will be allowed up to a 3 phase, 4 wire circuit in a single raceway, unless shared neutrals are not allowed by other sections of this Division, or are indicated as separate neutrals on the drawings. All receptacle circuits shall have dedicated neutrals. Any combination of homeruns such as this, however, shall be indicated on record drawings. Combining of conductors and raceways for tenant fitup work is allowed only for fitup boxes in accordance with details on drawings. When a common grounded conductor is used for more than one circuit, the arrangement shall be such that a receptacle, fixture, or other device may be removed or disconnected without disconnecting the grounded conductor for other circuits. Ground fault circuit breakers and isolated ground outlets shall be wired with separate neutrals and separate grounding conductors per circuit. A consistent phase orientation shall be adhered to throughout project at terminations.

C. Circuits feeding three phase equipment shall not be combined into common raceways, unless specifically indicated.

D. All wiring in panelboards and cabinets shall be neatly formed and grouped.

3.10 FIREPROOFING AND WATERPROOFING

A. Fireproof and waterproof all openings in slabs and walls.

3.11 CUTTING AND PATCHING

A. All cutting of surfaces, including core drilling of walls and slabs as called for on 1.02.B.11 shall be done by Electrical Subcontractor. Openings through new wall surfaces will be provided by General Contractor if Electrical Subcontractor gives suitable noticeas erection of surface proceeds. If suitable notice is not given, Electrical Subcontractor shall then be responsible for cost of corrective work required.

B. Patching will be provided by the trade responsible for the surface to be patched.

3.12 STORAGE AND INSTALLATION OF EQUIPMENT

A. The electrical subcontractor shall store and install electrical equipment and wiring listed for dry locations only after the building is watertight.

3.13 MECHANICAL SYSTEM COORDINATION

A. The Mechanical System contractor will be providing various items of mechanical services equipment and control apparatus. In general, Electrical contractor shall connect up power wiring to this equipment.

B. The Mechanical and Electrical contractor shall closely coordinate their respective portions of work.

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C. If, due to local regulations, electric heating equipment furnished by the mechanical systems subcontractor is required to be installed by licensed electricians in order to allow connection by Electrical contractor's licensed electricians, it will then be Mechanical contractor's responsibility to engage and pay for services of such licensed electricians.

D. Power wiring to be provided by Electrical contractor is the line voltage power supply wiring. Control wiring is responsibility of Mechanical System contractor unless specifically indicated on electrical drawings, or in this Division of the specifications. Temperature Control contractor shall refer to electrical drawings for location of all magnetic starters.

E. 120-volt control wiring source to temperature control panel is the responsibility of Electrical contractor.

END OF SECTION