University of California
Hastings College of the Law

200 McAllister, 6th Floor Tenant Improvements
San Francisco, California

UC HASTINGS
COLLEGE OF THE LAW
EST. 1878

ARCHITECT
MKTHINK
1500 Sansome Street
San Francisco, CA 94111

Project # 491-404-2
IBT # 78-0190

April 18, 2018

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END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The work of this Contract comprises limited demolition and construction tenant improvements for the University of California Hastings College of the Law, 200 McAllister, 6th Floor.

B. Perform work in accordance with the codes, ordinances, and amendments in effect in the location of the Project.

1.02 CONTRACTS

A. Perform the work per the Agreement to be executed between the Owner and Contractor.

1.03 WORK SEQUENCE

A. Perform the work in phases as indicated.

1.04 ACCESS TO SITE

A. Notify the City and County agencies, as applicable, a minimum of 48-hours in advance of performing work which necessitates closing or interfering with traffic on public thoroughfares. Obtain written permission prior to effecting such closures and interruptions.

1.05 CONTRACTOR USE OF PREMISES

A. During the construction period, the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor's use of the premises is limited only by Owner's right to perform construction operations with its own forces or to employ separate contractors on portions of the Project.

B. Nonsmoking Building: Smoking is not permitted within the building or within 25-feet of entrances, operable windows, or outdoor air intakes.

1.06 ADJACENT SITE CONDITION SURVEY

A. Prior to commencement of work, jointly survey the site, paving, plant life, and other items with the Owner, noting and recording existing damage such as cracks, sags, unhealthy plant life, and other damage. Provide preconstruction photo survey as part of the joint survey of the site.

B. This record shall serve as a basis for determination of subsequent damage to these items due to settlement, movement, or Contractor's operations.

C. Existing damage observed shall be marked and the official record of existing damage shall be signed by the parties making the survey.

D. Cracks, sags, and damage to the site, paving, plant life, and other items not noted in the original survey but subsequently observed shall be reported immediately to the Architect.

E. Provide monitoring of adjacent sites during construction for vibration and settlement.

1.07 PROTECTION & CONTINUOUS OPERATION OF EXISTING FIRE & LIFE SAFETY SYSTEMS

C. Contractor shall maintain operation of all building fire and life safety systems throughout the duration of demolition and construction, including fire alarms, sprinklers, and keep clear egress routes, doors and stairs. No storage of materials, supplies, or equipment shall be kept in fire stairs.

1.08 USE AND OCCUPANCY OF WORK PRIOR TO ACCEPTANCE BY OWNER

A. The Owner may use and occupy the building before formal acceptance under the following conditions:

1. A Certificate of Substantial Completion shall be prepared and executed as provided in the General Conditions. The Certificate of Substantial Completion shall be accompanied by a written endorsement of the Contractor's insurance carrier and surety permitting occupancy by the Owner during the remaining period of the work.

2. Occupancy by the Owner shall not be construed as being an acceptance of that part of the work occupied.

3. The Contractor will not be held responsible for damage to the occupied part of the work resulting from the Owner's occupancy.

4. Occupancy by the Owner shall not be deemed to constitute a waiver of existing claims the Owner or Contractor may have against each other.

5. If required by the Owner for areas it has occupied, the Contractor shall make available, on a 24 hour-a-day, 7 day-a-week basis, utility services, heating, and cooling which are in condition to be put in operation when such use and occupancy is taken. Responsibility for the operation and maintenance shall remain with the Contractor until the building is complete and the areas occupied, at which time operation and maintenance shall be assumed by the Owner if Contract requirements for such equipment have been met.

6. Make an itemized list of each piece of equipment operated during occupancy, with the date operation commences; submit to the Architect, who will transmit it to the Owner. This list shall be the basis for the commencement of guarantee/warranty periods on the equipment operated during the Owner's occupancy.

7. The Owner will pay for utility costs associated with occupancy during construction.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Aluminum Entrances and Storefronts.

Alternate Deduct: Provide Aluminum Storefront to match existing, to be verified with Owner, in lieu of Mimo by Muraflex frameless system.

B. Alternate No. 2: Carpet

Alternate Add: Provide carpet tile CPF-3 in public hallway as indicated on the drawing in lieu of reinstallation of existing carpet.

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install products specified, under options and conditions for substitutions stated in this Section.

1. Use Substitution Request Form attached at the end of this Section.

B. Related Sections:

1. Common product requirements are specified in Section 01 61 00.

1.02 SUBSTITUTIONS

A. Catalog numbers and specific brands or trade names are used in conjunction with material and equipment required by the Specifications to establish the standard of quality, utility, and appearance required. Substitutions which are equal in quality, utility, and appearance to those specified may be accepted subject to the following provisions:

1. All substitutions must be accepted in writing by the Architect.

2. The determination of the Architect after consultation with the Owner's Representative shall be final.

3. Failure of Contractor to submit proposed substitutions for approval in the manner described above and within the time prescribed shall be sufficient cause for disapproval by the Architect of any substitutions otherwise proposed.

4. The Architect will accept, in writing, proposed substitutions that are in Architect's opinion equal in quality, utility, and appearance to the material or equipment specified.

5. Such acceptance shall not relieve Contractor from complying with the requirements of the Drawings and Specifications.

6. Contractor shall be responsible for costs of any changes resulting from Contractor's proposed substitution which affect other parts of the work or the work of Separate Contractors, including the cost of the Architect's additional services, testing, permits thereby made necessary.

B. Requests for substitutions will only be considered if the Contractor submits the following:

1. Completed Submittal Form attached at the end of this Section.

2. Complete technical data including drawings, performance specifications, samples, and test reports of the article proposed for substitution; and any additional information required by the Architect or Owner's Representative.

3. Complete breakdown of costs, which shall include savings generated by the proposed substitution and shall indicate the amount, if any, to be deducted from the Contract Sum if the proposed substitution is accepted.

4. Statement by the Contractor that the proposed substitution is in full compliance with the requirements of the Contract Documents and Applicable Code Requirements.

5. List of other trades, if any, which may be affected by the substitution.

6. If the proposed substitution requires that portions of the Project be redesigned or construction be removed in order to accommodate the substituted item, submit design and engineering calculations prepared by a properly licensed design professional. The Contractor shall bear all costs resulting from the substitution.

C. Submit separate request form for each substitution. Support each request with:

1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents.

a. Product identification including manufacturer's name and address.

b. Manufacturer's literature; identify:

1) Products description.

2) Reference standards.

3) Performance and test data.

c. Samples, as applicable.

d. Name and address of similar projects on which product has been used, and date of each installation.

2. Itemized comparison of the proposed substitution with product specified; list significant variations.

3. Data relating to changes in construction schedule.

4. Any effect of substitution on separate contracts.

5. List of changes required on other work or products.

6. Accurate cost data comparing proposed substitution with product specified.

7. Designation of required license fees or royalties.

8. Designation of availability of maintenance services, sources of replacement materials.

D. Substitutions will not be considered for acceptance when:

1. They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.

2. They are requested directly by a subcontractor or supplier.

3. Acceptance will require substantial revision of Contract Documents.

4. Insufficient information is submitted.

E. Availability of Specified Items:

1. Verify prior to bidding that all specified items will be available in time for installation during orderly and timely progress of the work.

2. In the event specified item or items will not be so available, notify the Architect prior to receipt of bids.

3. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

F. Substitutions shall be considered as a Change Order and be approved by the Architect prior to fabrication or use.

1.03 CONTRACTOR'S REPRESENTATION

A. In making a formal request for substitution, Contractor represents that he/she:

1. Has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.

2. Will provide same warranties for substitution as for product specified.

3. Will coordinate installation of accepted substitution into the work and will make such changes as may be required for the work to be complete in all respects.

4. Waives claims for additional costs caused by substitution which may subsequently become apparent.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

END OF SECTION

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections:

1. Requests for Interpretation (RFI) are specified in Section 01 26 15.

1.02 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Proposed changes in the work that will require adjustment to the Contract Sum or Contract Time will be issued by the Architect, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.

1. Proposal requests issued by the Architect are for information only. Do not consider them an instruction either to stop work in progress, or to execute the proposed change.

2. Unless otherwise indicated in the proposal request, within 20-days of receipt of the proposal request, submit to the Architect for review an estimate of cost necessary to execute the proposed change.

a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include a statement indicating the effect the proposed change in the work will have on the Contract Time.

B. Contractor-Initiated Change Order Proposal Requests: When latent or other unforseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining the reasons for the change and the effect of the change on the work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.

2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Comply with requirements in Section 01 25 00 if the proposed change in the work requires the substitution of one product or system for a product or system specified.

5. Proposal Request Form: Use AIA Document G709 for Change Order Proposal Requests or a form furnished by the Owner's Representative.

C. Supplemental Instructions from the Architect (ASI): Use AIA Form G710 or a form furnished by the Owner's Representative.

1.03 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Change Order Proposal Request, the Architect may issue a Construction Change Directive on AIA Form G714 or other form furnished by the Owner's Representative, instructing the Contractor to proceed with a change in the work, for subsequent inclusion in a Change Order.

1. The Construction Change Directive will contain a complete description of the change in the work and designate the method to be followed to determine change in the Contract Sum or Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

C. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.04 CHANGE ORDER PROCEDURES

A. Upon the Owner's Representative's approval of a Change Order Proposal Request, the Contractor shall issue a Change Order for signatures of the Owner or Owner's Representative, Architect, and Contractor on AIA Form G701 or other form furnished by the Owner's Representative, as provided in the Conditions of the Contract.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 26 15

REQUESTS FOR INTERPRETATION (RFI)

PART 1 – GENERAL

1.01 GENERAL

A. This Section contains the procedures to be followed by the Contractor upon discovery of any apparent conflicts, omissions, or errors in the Contract Documents or upon having any question concerning interpretation.

1.02 DEFINITIONS

A. Requests for Interpretation: A request from the Contractor seeking an interpretation or a clarification of some requirement of the Contract Documents. The Contractor shall clearly and concisely set forth the issue requiring clarification or interpretation and why a response is needed. Include in the request interpretation or understanding of the contract's requirements along with documentation for the interpretation or understanding. Responses from the Architect will not change any requirements of the Contract Documents.

B. Drawing/Plan Clarification: An answer from the Architect in response to an inquiry from the Contractor, intended to make some requirement(s) of the drawings clearly understood. Drawing/plan clarifications may be sketches, drawings, or in narrative form and will not change any requirements of the drawings.

C. Non-Conformance Notice: A notice issued by the Architect documenting that the work or some portion thereof has not been performed in accordance with the requirements of the Contract Documents. Payment will not be made on any portion of the work for which a Non-Conformance Notice has been issued and the work not corrected to the Satisfaction of the Architect. Upon receipt of a Non-Conformance Notice, the Contractor shall provide a written response within 5 working days after receipt, noting why they believe the work was performed in accordance with the Contract Documents or what corrective action they intend to take to correct the non-conforming work. Written responses from the Contractor are not considered to be RFI's.

D. Project Communications: Routine written communications between the Architect and Contractor shall be in writing, field memo, e-mail, or FAX. Such communications shall not be identified as RFI's.

1.03 PROCEDURES

A. Notification by Contractor:

1. Submit all requests for clarification of additional information in PDF format to the Architect using the Request for Interpretation (RFI) Form attached at the end of this Section or other form approved by the Architect.

2. Number RFIs sequentially. Follow RFI number with sequential alphabetical suffix as necessary for each resubmission. For example, the first RFI would be "1"; the second RFI would be "2." The first resubmittal of RFI "2" would be "2a", etc.

3. Limit each RFI to one subject.

4. Submit a RFI if one of the following conditions occurs:

a. The Contractor discovers an unforeseen condition or circumstance that is not described in the Contract Documents.

b. The Contractor discovers an apparent conflict or discrepancy between portions of the Contract Documents that appears to be inconsistent or cannot be reasonably inferred from the intent of the Contract Documents.

c. The Contractor discovers what appears to be an omission from the Contract Documents that cannot be reasonably inferred from the intent of the Contract Documents.

5. RFIs will not be recognized or accepted if, in the opinion of Architect, one of the following conditions exists:

a. The Contractor submits the RFI as a request for substitution.

b. The Contractor submits the RFI as a submittal.

c. The Contractor submits the RFI under pretense of a Contract Documents discrepancy or omission without thorough review of the Contract Documents.

d. The Contractor submits the RFI in a manner that suggest that specific portions of the Contract Documents are assumed to be excluded or by taking an isolated portion of the Contract Documents in part rather than whole.

e. The Contractor submits an RFI in an untimely manner without proper coordination and scheduling of Work of related trades.

6. Ask for any clarification or request for interpretation immediately upon discovery. Submit RFIs in a reasonable time frame so as not to affect the Contract Schedule while allowing the full response time specified below.

1.04 RESPONSE TIME

A. The Architect, whose decision will be final and conclusive, will resolve such questions and issue instructions to the Contractor within a reasonable time frame. In most cases, RFIs will receive a response within 10 working days. In some cases this time may need to be lengthened for complex issues, or shortened for emergency situations, as mutually agreed in writing.

B. Should the Contractor proceed with the work affected before receipt of a response from the Architect, within the response time specified above, any portion of the work that is not done in accordance with the Architect's interpretations, clarifications, instructions, or decisions is subject to removal or replacement and the Contractor shall be responsible for all resultant losses.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section includes progress payment procedures.

B. Related Sections:

1. Schedule of values is specified in Section 01 29 73.

1.02 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.

1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction work covered by each Application or Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and Continuation Sheets G703 or other forms provided by the Owner as the form for Application for Payment.

D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.

2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

E. Transmittal: Submit 3 executed copies of each Application for Payment to the Architect by means ensuring receipt within 24-hours; one copy shall be complete, including waivers of lien and similar attachments, when required.

1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Architect.

F. Waivers of Mechanics Lien: With each Application for Payment, submit waivers of Mechanics Lien from every entity who may lawfully be entitled to file a mechanics lien arising out of the Contract, and related to the work covered by the payment.

1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.

2. When an application shows completion of an item, submit final or full waivers.

3. The Owner reserves the right to designate which entities involved in the work must submit waivers.

4. Waiver Delays: Submit each Application for Payment with the Contractor's waiver of mechanics lien for the period of construction covered by the application.

5. Submit final Application for Payment with or proceeded by final waivers from every entity involved with performance of work covered by the application who could lawfully be entitled to a lien.

6. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that shall precede or coincide with submittal of the first Application for Payment include the following:

1. List of subcontractors.

2. List of principal suppliers and fabricators.

3. Schedule of Values.

4. Contractor's Construction Schedule (preliminary if not final).

5. Schedule of principal products.

6. Schedule of unit prices.

7. Submittal Schedule (preliminary if not final).

8. List of Contractor's staff assignments.

9. List of Contractor's principal consultants.

10. Copies of building permits.

11. Copies of authorizations and licenses from governing authorities for performance of the work.

12. Initial progress report.

13. Report of pre-construction meeting.

14. Certificates of insurance and insurance policies.

15. Performance and payment bonds (if required).

16. Data needed to acquire Owner's insurance.

17. Initial settlement survey and damage report, if required.

H. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the work.

1. Administrative actions and submittals that shall proceed or coincide with this application include:

a. Occupancy permits and similar approvals.

b. Warranties (guarantees) and maintenance agreements.

c. Test/adjust/balance records.

d. Maintenance instructions.

e. Meter readings.

f. Start-up performance reports.

g. Change-over information related to Owner's occupancy, use, operation and maintenance.

h. Final cleaning.

i. Application for reduction of retainage, and consent of surety.

j. Advice on shifting insurance coverage.

k. Final progress photographs.

l. List of incomplete work, recognized as exceptions to Architect's Certificate of Substantial Completion.

I. Final Payment Application: Administrative actions and submittals which shall precede or coincide with submittal of the final payment Application for Payment include the following:

1. Completion of Project closeout requirements.

2. Completion of items specified for completion after Substantial Completion.

3. Assurance that unsettled claims will be settled.

4. Assurance that work not complete and accepted will be completed without undue delay.

5. Transmittal of required Project construction records to Owner.

6. Certified property survey.

7. Proof taxes, fees and similar obligations have been paid.

8. Removal of temporary facilities and services.

9. Removal of surplus materials, rubbish and similar elements.

10. Change of door locks to Owner's access.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies administrative and procedural requirements governing the preparation of a Schedule of Values.

B. Related Sections:

1. Payment procedures are specified in Section 01 29 00.

1.02 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.

B. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:

1. Contractor's construction schedule.

2. Application for Payment form.

3. List of subcontractors.

4. Schedule of allowances.

5. Schedule of alternates.

6. List of products.

7. List of principal suppliers and fabricators.

8. Schedule of submittals.

C. Submit the Schedule of Values to the Architect at the earliest feasible date, but in no case later than 7-days before the date scheduled for submittal of the initial Application for Payment.

D. Sub-Schedules: Where the work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

E. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.

1. Identification: Include the following Project identification on the Schedule of Values:

a. Project name and location.

b. Name of the Architect.

c. Project number.

d. Contractor's name and address.

e. Date of submittal.

2. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

a. Generic name.

b. Related Specification Section.

c. Name of subcontractor.

d. Name of manufacturer or fabricator.

e. Name of supplier.

f. Change Orders (numbers) that have affected value.

g. Dollar value.

h. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

4. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

5. For each part of the work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the work.

F. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.

1. At the Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.

G. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:

1. Coordination.

2. Administrative and supervisory personnel.

3. General installation provisions.

4. Cleaning and protection.

1.02 COORDINATION

A. Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.

1. Where installation of one part of the work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.

2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.

2. Installation and removal of temporary facilities.

3. Delivery and processing of submittals.

4. Progress meetings.

5. Project Close-out activities.

1.02 SUBMITTALS

A. Coordination Drawings: Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the interrelationship of components shown on separate Shop Drawings.

2. Indicate required installation sequences.

3. Comply with requirements contained in Section 01 33 00.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION PROVISIONS

A. General: The provisions in this Article are in addition to and are intended to supplement specific installation requirements specified in other Sections.

B. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

C. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

D. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

E. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.

F. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

G. Recheck measurements and dimensions, before starting each installation.

H. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

I. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

J. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

3.02 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

END OF SECTION

SECTION 01 31 15

ACOUSTIC GENERAL REQUIREMENTS & QUALITY CONTROL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The specified acoustical assemblies require careful fitting and sealing of building components to achieve airtight construction. Coordination between trades is required at work interfaces to minimize penetrations of ducts, pipes and conduits. All acoustical materials and accessories shall be installed in conformance with the relevant manufacturer's instructions. All interior insulated partitions, floors and ceilings are to be considered sound-rated UON.

B. Perform work in accordance with the drawings.

1.02 QUALITY CONTROL

A. Notify Architect and Acoustical Consultant prior to covering or enclosing framing, isolators, ducts, and pipes in sound-rated constructions to allow for on-site review and correction as required.

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:

1. Pre-Construction Conference.

2. Pre-Installation Conferences.

3. Coordination Meetings.

4. Progress Meetings.

5. Warranty Closeout Meeting.

1.02 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction conference and organizational meeting at the Project site no later than 15-days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

B. Contractor shall take and distribute meeting notes to the attendees. Attendees taking exception to any item on the meeting notes shall notify the Contractor within 3-days following receipt.

C. Attendees:

1. Owner's Representative.

2. Owner personnel as appropriate; representative from Physical Plant, Business Office, and Security, as applicable.

3. Architect and applicable professional consultants.

4. Contractor.

5. Contractor's Superintendent.

6. Major subcontractors.

7. Others as appropriate.

D. Agenda: Discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule.

2. Critical work sequencing.

3. Designation of responsible personnel.

4. Procedures for processing field decisions and Change Orders.

5. Procedures for processing Applications for Payment.

6. Distribution of Contract Documents.

7. Submittal of Shop Drawings, Product Data and Samples.

8. Preparation of record documents.

9. Use of the premises.

10. Office, work and storage areas.

11. Equipment deliveries and priorities.

12. Safety procedures.

13. First aid.

14. Security.

15. Housekeeping.

16. Working hours.

1.03 PRE-INSTALLATION CONFERENCES

A. Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Architect of scheduled meeting dates.

B. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:

1. Contract Documents.

2. Options.

3. Related Change Orders.

4. Purchases.

5. Deliveries.

6. Shop Drawings, Product Data and quality control Samples.

7. Possible conflicts.

8. Compatibility problems.

9. Time schedules.

10. Weather limitations.

11. Manufacturer's recommendations.

12. Compatibility of materials.

13. Acceptability of substrates.

14. Temporary facilities.

15. Space and access limitations.

16. Governing regulations.

17. Safety.

18. Inspection and testing requirements.

19. Required performance results.

20. Recording requirements.

21. Protection.

C. Record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner's Representative and Architect.

D. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of work and reconvene the conference at the earliest feasible date.

1.04 PROGRESS MEETINGS

A. Conduct progress meetings at the Project site at regularly scheduled intervals. Notify the Owner's Representative and Architect of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.

B. Attendees:

1. Owner's Representative.

2. Architect and applicable professional consultants.

3. Contractor.

4. Contractor's Superintendent.

5. Subcontractors as appropriate to the agenda.

6. Suppliers as appropriate to the agenda.

7. Others as appropriate to the agenda.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress, Include topics for discussion as appropriate to the current status of the Project.

D. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

E. Review the present and future needs of each entity present, including such items as:

1. Interface requirements.

2. Time.

3. Sequences.

4. Deliveries.

5. Off-site fabrication problems.

6. Access.

7. Site utilization.

8. Temporary facilities and services.

9. Hours of work.

10. Hazards and risks.

11. Housekeeping.

12. Quality and work standards.

13. Change Orders.

14. Documentation of information for payment requests.

F. Reporting: Take and distribute copies of minutes of the meeting to each party present and to other parties who should have been present no later than 3-days after each progress meeting date. Include a brief summary, in narrative form, of progress since the previous meeting and report.

G. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

1.05 WARRANTY CLOSEOUT MEETING

A. Eleven months following date of Substantial Completion, hold a meeting to review warranties, bonds, and service and maintenance contracts for materials and equipment. Take action as appropriate to implement, repair, or replace defective items and to extend service and maintenance contracts.

B. Attending shall be:

1. Owner's Representative.

2. Architect and professional consultants, as appropriate.

3. Contractor.

4. Subcontractor, as appropriate to the Agenda.

5. Suppliers, as appropriate to the Agenda.

6. Others, as appropriate to the Agenda.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Payment procedures are specified in Section 01 29 00.

2. Operation and maintenance data is specified in Section 01 78 23.

3. Project record documents are specified in Section 01 78 39.

1.02 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.03 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60-days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.

b. Specification Section number and title.

c. Submittal Category: Action or informational.

d. Name of subcontractor.

e. Description of the Work covered.

f. Scheduled date for Architect's final release or approval.

g. Scheduled date of fabrication.

h. Scheduled dates for purchasing.

i. Scheduled dates for installation.

j. Activity or event number.

1.02 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Processing Time: Allow time for submittal review, including time for re-submittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including re-submittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

3. Resubmittal Review: Allow 15 days for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.

   a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., Project Name-06 10 00.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., Project Name-06 10 00.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software or electronic form acceptable to Owner**,** containing the following information:

   a. Project name.

   b. Date.

   c. Name and address of Architect.

   d. Name of Contractor.

   e. Name of subcontractor.

   f. Name of supplier.

   g. Name of manufacturer.

   f. Submittal number or other unique identifier, including revision identifier.

      1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 10 00.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., 06 10 00.01.A).

   g. Number and title of appropriate Specification Section.

   h. Drawing number and detail references, as appropriate.

   i. Location(s) where product is to be installed, as appropriate.

   j. Other necessary identification.

   k. Submittal and transmittal distribution record.

   l. Remarks.

D. Options: Identify options requiring selection by Architect.

E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous

submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

F. Re-submittals: Make re-submittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

4. The Architect will review up to one re-submittal. If more than one re-submittal is required, any associated costs as a result of additional reviews by the Architect will be charged to the Contractor and processed as a deductive Change Order in accordance with the General Conditions.

G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.

b. Manufacturer's product specifications.

c. Standard color charts.

d. Statement of compliance with specified referenced standards.

e. Testing by recognized testing agency.

f. Application of testing agency labels and seals.

g. Notation of coordination requirements.

h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.

b. Printed performance curves.

c. Operational range diagrams.

d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.

6. Submit Product Data in the following format: PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.

b. Schedules.

c. Compliance with specified standards.

d. Notation of coordination requirements.

e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.

g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2-inches x 11-inches, but no larger than 30-inches x 42-inches.

3. Submit Shop Drawings in the following format: PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.

    b. Product name and name of manufacturer.

    c. Sample source.

    d. Number and title of applicable Specification Section.

    e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are specified in individual Specification Sections. Such Samples shall be in an undamaged condition at time of use.

    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: If specified in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.

2. Manufacturer and product name, and model number if applicable.

3. Number and name of room or space.

4. Location within room or space.

5. Submit product schedule in the following format: PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00.

G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 33 00.

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00.

I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00.

J. Maintenance Data: Comply with requirements specified in Section 01 78 23.

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding

1. Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

R. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by

manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.

2. Date of evaluation.

3. Time period when report is in effect.

4. Product and manufacturers' names.

5. Description of product.

6. Test procedures and results.

7. Limitations of use.

T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.02 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

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

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit **digitally signed PDF electronic file** of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

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

PART 3 – EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00.

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for re-submittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

F. Submittals requiring review by authorities having jurisdiction shall be made to the Architect for initial review prior to being submitted to the appropriate authority.

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.01 DEFINITIONS

A. Soils Engineer: A civil engineer, licensed in the State of California, retained and paid by the Owner to perform services as specified.

B. Testing Laboratory: An independent commercial testing organization, retained and paid by the Owner to perform tests and report on work as specified and as required.

1.02 SOILS ENGINEER

A. Services of a Soils Engineer are required for work specified in other Sections.

1.03 TESTING LABORATORY

A. General: Services of a Testing Laboratory are required for work specified in other Sections.

B. Contractor's Responsibilities:

1. Cooperate with Testing Laboratory personnel.

2. Secure and deliver to the Testing Laboratory adequate quantities of representational samples of materials proposed for use for which testing is required.

3. Furnish copies of product test reports as required.

4. Furnish incidental labor and facilities:

a. To provide access to work to be tested.

b. To obtain and handle samples at the Project site or at the source of the product to be tested.

c. To facilitate inspections and tests.

d. For storage and curing of test samples.

5. Notify the Architect sufficiently in advance of operations to allow for Testing Laboratory assignment of personnel and scheduling of tests.

a. When tests or inspections cannot be performed after such notice, reimburse the University for the Testing Laboratory personnel and travel expenses incurred.

1.04 TEST REPORTS

A. The Testing Laboratory will distribute reports as follows:

1. Architect: One copy.

2. Applicable Consultant: One copy.

3. Owner’s Representative: One copy.

4. Number of copies for Contractor and supplier will be determined upon commencement of the work.

5. City and State agencies as appropriate.

1.05 RETESTING

A. If the Architect has reasonable doubt that materials comply with Specification requirements, additional tests shall be made as directed.

1. If additional tests establish that materials comply with Specification requirements, costs for such tests will be paid by the Owner.

2. If additional tests establish that materials do no comply with Specification requirements, costs for such tests shall be paid by the Contractor.

B. The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicated compliance with the Contract Documents.

1. Cost of retesting shall be paid for by the Contractor.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish, install, and maintain temporary utilities as required to perform the work.

B. Materials, installation, and maintenance of temporary utilities shall be in compliance with applicable regulatory requirements.

C. Remove temporary utilities, including associated materials and equipment when no longer required. Restore and recondition areas of the site damaged or disturbed by temporary utilities or their installation. Remove and properly dispose of debris resulting from removal and reconditioning operations.

1.02 TEMPORARY UTILITIES

A. Temporary Electric Power and Lighting:

1. Arrange with electric utility service company to provide service for power and lighting. Pay the costs for service and for power used.

2. Distribute electric power and lighting.

3. Provide lighting and convenience outlets in the temporary structures, and as otherwise required for the performance of the work.

B. Temporary Heat and Ventilation:

1. Provide and pay for heat devices and heat as required to maintain specified conditions for construction operations.

2. The permanent heating system may be used as a source of temporary heat after system is placed in operation and tested, provided Owner's Representative has approved, in writing, use of permanent system for temporary heat.

3. Make arrangements for service, provide fuel and operators as required, pay costs in connection therewith, and maintain system until acceptance of the Project.

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

5. Building supply fans shall not be used unless required filters are in place.

C. Temporary Lighting:

1. Provide artificial lighting for work areas when natural light is not adequate to inspect work.

2. Exterior staging and storage areas and pathways shall remain electrically illuminated after dark.

3. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

D. Temporary Telephone:

1. Provide, maintain and pay for telephone service to field office at time of Project mobilization.

2. Contractor is responsible for collecting toll charges for phone calls made by unauthorized personnel.

E. Temporary Water:

1. Arrange with utility service company to provide temporary water service and distribution; pay the costs for service and for water used.

2. Following permanent service installation, temporary water may be taken from permanent source.

3. Install branch piping with taps located so that water for construction purposes is available throughout the work by the use of hoses.

4. Make potable water available for human consumption.

F. Temporary Sanitary Facilities: Locate as approved by the Owner. Maintain in a neat, sanitary condition, adequately supplied.

1.04 CONSTRUCTION AIDS

A. Plant and Equipment:

1. Furnish, operate, and maintain a complete plant for fabricating, handling, conveying, installing, and erecting work and materials required under the Contract. Include hoists and conveyances for transporting workers and transporting and placing materials; debris chutes; and tools, appliances, power equipment, and other required items. Furnish, arrange, and set up the plant to facilitate the proper and timely performance of the work.

2. Maintain plant and equipment in safe operating condition. Repair damages due to the use of defective plant and equipment, at no increase in Contract Sum.

B. Use of New Elevators and Stairs:

1. As soon as practical after installation, a designated new elevator and stairway may be placed in service for use for construction operations.

2. Protect elevator and stairway from damage from construction operations.

3. Do not overload elevator and stairway beyond their rated capacities.

1.05 BARRIERS AND ENCLOSURES

A. General:

1. Materials and construction shall be in compliance with applicable regulatory requirements.

2. Provide and maintain suitable temporary barriers as required to prevent public entry; protect the work and existing facilities, and persons from damage or injury from construction operations.

3. Should regulatory requirements necessitate construction of temporary barriers, barricades, or pedestrian walkways not indicated or specified, construct at no increase in Contract Sum.

4. Install enclosure fencing with locking entrance gates where indicated or required to enclose site work. Provide open-mesh, chain-link fencing with posts.

5. Maintain temporary barriers in a structurally sound condition and neat appearance.

6. Relocate as required by progress of the work.

7. Restore and recondition site areas damaged or disturbed.

B. Provide and maintain temporary enclosures to separate work areas from areas occupied by Owner and to prevent the penetration of dust and noise into occupied spaces.

1. Construct with closed, sealed joints. Close or seal edges, penetrations, and intersections with other surfaces to prevent penetrations of dust and noise.

2. Construct in accordance with fire-resistive requirements of regulatory agencies where indicated; maintain fire exits.

3. Finish surfaces exposed to view in occupied areas as directed.

1.06 SECURITY

A. Secure, maintain, and protect the work, stored materials, equipment, and temporary facilities until time of acceptance, or such earlier time as Owner may choose to assume such responsibility.

B. Install temporary enclosure of partially completed construction areas to prevent unauthorized entrance, vandalism and theft.

C. Secure temporary storage areas as required to prevent theft.

1.07 TEMPORARY CONTROLS

A. Noise and Vibration Control:

1. Comply with applicable regulatory requirements for the operation of powered construction equipment.

2. Equipment and impact tools shall have intake and exhaust mufflers.

3. Secure written permission from Owner's Representative at least three working days prior to using noisy and vibratory equipment, such as jack-hammers, concrete saws, impact tools, and high frequency electrical equipment.

4. Cooperate with Owner's Representative if the use of noisy equipment becomes objectionable.

B. Dust and Dirt Control:

1. Conduct construction operations to prevent windblown dust and dirt from interfering with the progress of the work.

2. Periodically water exterior construction areas as required to minimize the generation of dust and dirt.

3. Hauling equipment and trucks carrying loads of soil and debris shall have their loads sprayed with water or covered with tarpaulins.

4. Prevent dust and dirt from accumulating on walks, roadways, parking areas, and planting, and from washing into sewer and storm drains.

C. Water Control: Do not permit surface or subsurface water, and other liquids to accumulate on or in areas adjacent to the Project site. Should such conditions be encountered or develop, control the water, or other liquid, and suitably dispose of by means of temporary pumps, piping, drainage lines, troughs, ditches, dams, or other methods.

D. Pollution Control:

1. No burning of refuse, debris, or other materials will be permitted on or in the vicinity of the Project site.

2. Comply with regulatory requirements and anti-pollution ordinances during the performance of demolition, construction and disposal operations.

E. Construction Emissions Minimization Plan: Comply with Mitigation Measure M-AQ-5: Construction Emissions Minimization Plan requirements of the San Francisco Planning Department Mitigated Negative Declaration requirements.

1.08 PROJECT IDENTIFICATION AND SIGNS

A. General: Project identification and signs shall be approved by the Owner's Representative.

B. Provide and maintain a Project identification sign of the size, design, text, and colors designated by the Architect; locate sign as directed.

C. Signs other than the specified Project sign will not be permitted, unless otherwise approved in advance by the Owner's Representative.

D. Materials:

1. Structure and Framing: Structurally sound, new or used wood or metal; wood shall be nominal 2-inch x 4-inch minimum size.

2. Sign Surface: Minimum 3/4-inch exterior grade plywood.

3. Rough Hardware: Galvanized.

E. Fabrication:

1. Fabricate to provide smooth, even surface for painting.

2. Size: As indicated or directed.

3. Paint exposed surfaces of supports, framing, and surface material with one coat of primer and one coat of finish paint.

4. Text and Graphics: As directed by the Architect.

1.09 FIELD OFFICES AND SHEDS

A. Furnish, install, and maintain field offices and sheds.

B. Existing facilities at the Project site may be available for use for field offices or storage if coordinated with and approved by the Owner's Representative.

C. If required, construct, install, and maintain field offices and sheds in compliance with applicable regulatory requirements.

1. Construction shall be structurally sound, weathertight, with floors raised above the ground, sturdy doors with provisions for locking, temperature transmission resistance compatible with occupancy and storage requirements, and neat appearance maintained throughout duration of work.

2. Portable or mobile buildings complying with the specified requirements may be used.

3. Obtain Owner's Representative's approval of locations for field offices and storage sheds prior to commencing site preparation for the structures.

4. Construct field offices and sheds on proper foundations, and provide connections for utility services. Fill and grade sites for field offices and storage sheds to facilitate surface drainage.

D. Remove field offices and sheds from the site as soon as the progress of the work permits. Remove foundations, steps, landings, utility services and contents. Grade and restore portions of the site occupied by the temporary structures.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interferences with performance of the work. Relocate and modify facilities as required by progress of the work.

END OF SECTION

SECTION 01 61 00

COMMON PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

B. Administrative procedures for handling requests for substitutions made after award of the Contract are specified in Section 01 25 00.

1.02 REFERENCES

A. CDHS-SP – California Department of Health Services Standard Practice for The Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 20004 Addenda.

B. GreenSeal GC-03 – Anti-Corrosive Paints; 2nd Edition, January 7, 1997.

C. GreenSeal GS-11 –Paints; 1st Edition, May 20, 1993.

D. GreenSeal GS-36 – Commercial Adhesives; October 19, 2000.

E. SCAQMD 1113 – South Coast Air Quality Management District Rule No. 1113; Rules in effect on January 1, 2004; www.aqmd.gov.

1.03 DEFINITIONS

A. "Products" are items purchased for incorporation in the work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

B. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturers' published product literature, current as of the date of the Contract Documents.

C. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the work.

D. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.04 SUBMITTALS

A. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product name for each item listed.

1. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.

2. Form: Prepare the product listing schedule with information on each item tabulated under the following column headings:

a. Related Specification Section number.

b. Generic name used in Contract Documents.

c. Proprietary name, model number and similar designations.

d. Manufacturer's and name and address.

e. Supplier's name and address.

f. Installer's name and address.

g. Projected delivery date, or time span of delivery period.

3. Initial Submittal: Within 30-days after date of commencement of the work, submit 3-copies of an initial product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

a. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.

4. Completed Schedule: Within 60-days after date of commencement of the work, submit 3-copies of the completed product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

5. Architect's Action: The Architect will respond in writing to the Contractor within 2-weeks of receipt of the completed product list schedule. No response within this time period constitutes no objection to listed manufacturers or products, but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include the following:

a. A list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.05 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also optional.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturers' or producers' nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

a. Name of product and manufacturer.

b. Model and serial number.

c. Capacity.

d. Speed.

e. Ratings.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

B. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

C. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

D. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

E. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.

F. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

G. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

H. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.01 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 outside the United States, its territories, Canada or Mexico.

2. Made using or containing CFC’s or HCFC’s.

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

C. Where all other criteria are met, Contractor shall give preference to products that:

1. Are extracted, harvested, and/or manufactured closer to the location of the Project.

2. Have longer documented life span under normal use.

3. Result in less construction waste.

4. Are made of vegetable materials that are rapidly renewable.

2.02 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are

undamaged and, unless otherwise indicated, unused at the time of installation.

1. Provide products complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.

2. Semi-Proprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.

3. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

4. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

5. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

6. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.

7. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with a code, standard or regulation, select a product that complies with the standards, codes or regulations specified.

8. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final an whether a proposed product matches satisfactorily.

9. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.

PART 3 - EXECUTION

3.01 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other work.

B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 01 64 00

OWNER-FURNISHED PRODUCTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for the following:

1. Providing utility and rough-ins and installing Owner-furnished products.

2. Relocating existing products as indicated and specified.

3. Provide utility and rough-ins as required for Owner-furnished and installed products.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Store and handle products upright and in accordance with the manufacturer's instructions.

C. Protect products as required to prevent damage during storage and construction.

PART 2 - PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Contractor's Responsibilities:

1. Verify mounting and utility requirements for specified product items.

2. Provide mounting and utility rough-in for product items where required, regardless of responsibility designation.

a. Rough-in locations, sizes, capacities, and similar type items shall be as indicated and required by product manufacturer.

b. If the Owner substitutes items similar to those scheduled, there shall be no change in rough-in cost, unless substitution occurs after rough-in has been completed or rough-in involves other mounting requirements, utilities or utilities of different capacity from that required by item originally specified.

3. For products designated to be Owner furnished, the Owner will make available manufacturer's literature or information and shop drawings showing required mounting and rough-in information.

B. Products furnished by the Owner, installed by the Contractor (OFCI)

1. General: The Owner and the Contractor will coordinate deliveries to coincide with construction schedule.

2. The Owner will furnish specified products with rough-in dimensions and characteristics indicated and tailgate deliver to the site.

3. The Contractor Shall:

a. Receive products at site and give written receipt at time of delivery, noting visible defects or omissions; if such declaration is not given, the Contractor shall assume responsibility for such defects and omissions.

b. Store products until ready for installation and protect from loss and damage.

c. Uncrate, assemble, and set in place.

d. Provide required backing plates.

e. Install products in accordance with manufacturer's recommendations, instructions, and shop drawings under supervision of manufacturer's representative where specified, supplying labor and material required and making mechanical, plumbing, and electrical connections required to operate products.

C. Existing Products to be Relocated and Installed by the Contractor:

1. The Contractor Shall:

a. Remove products from present location when directed by the Owner or Architect.

b. Recap and label existing utilities at present location.

c. Store products as required and protect from loss and damage.

d. Relocate products to new location.

e. Install products, supplying labor and material required and making mechanical, plumbing, and electrical connections as required.

f. Patch or repair surfaces to match existing as specified in Section 01 73 29.

D. Compatibility with Space and Service Requirements:

1. Products shall be compatible with space limitations indicated and with mechanical and electrical services indicated and specified in other Sections.

2. Modifications to products required to conform with space limitations or with utility services specified for rough-in shall not cause additional cost to the Owner.

E. Manufacturer's printed descriptions, specifications, and instructions shall govern the work unless specifically indicated or otherwise specified.

F. Specifications, standards, tests, and recommended methods cited in this Section to govern use of items of equipment shall also govern component parts.

2.02 OWNER-FURNISHED PRODUCTS

A. Owner-furnished products and existing products to be relocated are indicated on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with the manufacturers' instructions.

B. Set items securely in place, rigidly or flexibly mounted in accordance with manufacturer's directions.

C. Securely attach to backing plates as required.

D. Where products are welded to embeds or similar installed supports, welding quality shall comply with applicable specifications specified in Section 05 50 00, and when exposed in the completed work, shall be smooth, flush and imperceptible.

E. Make electrical and mechanical connections as indicated and required.

F. Touch-up and restore damaged or defaced finishes.

3.02 ADJUSTMENT, CLEANING, AND PROTECTION

A. Repair or replace items not acceptable to the Architect.

B. Upon completion of installation, clean products in accordance with manufacturers' recommendations, and protect from damage until final acceptance of the work.

3.03 TESTING

A. Contractor-installed products shall be tested after installation in the presence of the Owner, Architect, and manufacturer.

B. Correct defects or replace and retest as required. Repairs, replacement, and retesting shall be made at no additional cost to the Owner.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for performing cutting and patching.

B. Cutting and patching includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

1.02 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.

2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.

3. List products to be used and firms or entities that will perform work.

4. Indicate dates when cutting and patching is to be performed.

5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.

6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.

B. Furnish record of experience qualifying the roofing installation firm as a specialist in the installation of the existing system or similar system. Include a written record indicating Projects on which the installer has worked, with the name and address of the purchasers of the service and location of the work performed.

1.03 QUALITY ASSURANCE

A. Structural Work: Do not cut and patch structural elements in a manner that would reduce their load carrying capacity or load deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall be identical to existing materials. If identical materials are not available, use materials that visually match existing adjacent surfaces.

PART 3 - EXECUTION

3.01 INSPECTION

A. Before cutting existing surface, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

3.02 PREPARATION

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

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

2. Take precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

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

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible, review proposed procedures with the original installer; comply with the original installer's recommendations.

1. Where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.

4. Bypass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or

other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.

4. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched areas has received primer and second coat.

5. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.04 CLEANING

A. Clean areas and spaces where cutting and patching is performed or used as access. Remove paint, mortar, oils, putty and similar materials. Clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original conditions.

END OF SECTION

SECTION 01 74 00

CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Perform cleaning and disposal operations during the progress and completion of the work.

B. Cleaning for specific products or work is specified in the individual Specification Sections.

C. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Comply with applicable regulatory requirements during cleaning and disposal operations.

B. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

C. Vacuum cleaners shall have high efficiency particulate arrester (HEPA) filters. Provide environmentally benign cleaning materials, which can be found at www.sustainable-cleaning.com and www.cleanersolutions.com. Be especially careful during final touch-up and cleaning to ensure that cleaning crews do not deviate from the low or zero VOC content requirement for VOC-containing cleaning products.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS

A. Use cleaning materials which will not create hazards to health or property or cause damage to products.

B. Use cleaning materials and methods recommended by the manufacturers of the products to be cleaned.

C. Cleaning materials shall be clearly labeled.

PART 3 - EXECUTION

3.01 CLEANING DURING CONSTRUCTION

A. Perform cleaning operations as required to keep the work, site, and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

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

C. Remove waste materials, debris and rubbish from the site on a weekly basis or more often as conditions require and dispose of at legal disposal areas away from the site.

D. Retain stored items in an orderly arrangement allowing access. Do not impede traffic or drainage.

3.02 DUST CONTROL

A. Clean interior spaces prior to the start of finish painting and the application of other finishes, and continue cleaning as required until such work is completed.

B. Schedule cleaning operations to prevent dust and other contaminants from adhering to wet or newly finished surfaces.

3.03 FINAL CLEANING

A. Employ experienced workers or professional cleaners for final cleaning. Comply with manufacturer's instructions.

B. Remove labels that are not permanent.

C. Clean transparent materials, including mirrors and glass in doors and windows, both interior and exterior. Remove glazing compound and other substances that are visible vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

D. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Vacuum carpeted surfaces. Other flooring surfaces shall be mopped and/or cleaned in accordance with flooring manufacturer's recommendations.

E. For surfaces requiring routine application of buffed polish, apply the polish recommended by the flooring manufacturer and polish.

F. Clean permanent filters and replace disposable filters one week prior to building occupancy.

G. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures, lamps and bulbs. Clean out strainers after equipment start-up.

H. Clean site, including landscape development areas of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth even textured surface.

I. Remove temporary protection and facilities installed for protection of work during construction.

J. Prior to final completion or Owner's occupancy, conduct an inspection of sight-exposed interior and exterior surfaces to verify that the entire work is clean and acceptable to the Owner.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.

2. Recycling nonhazardous demolition and construction waste.

3. Disposing of nonhazardous demolition and construction waste.

B. Related Sections:

1. Selective demolition is specified in Section 02 41 19.

1.02 DEFINITIONS

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

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

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

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

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

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

1.03 PERFORMANCE REQUIREMENTS

A. Recycle cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum board, carpet and insulation.

1.04 SUBMITTALS

A. Waste Management Plan: Submit three copies of plan within 30-days of date established for the Notice to Proceed.

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

1. Material category.

2. Generation point of waste.

3. Total quantity of waste in tons.

4. Quantity of waste salvaged, both estimated and actual in tons.

5. Quantity of waste recycled, both estimated and actual in tons.

6. Total quantity of waste recovered (salvaged plus recycled) in tons.

7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Qualification Data: For Waste Management Coordinator and refrigerant recovery technician.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.05 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: LEED Accredited Professional by U.S. Green Building Council.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having Jurisdiction.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 13. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.

2. Review requirements for documenting quantities of each type of waste and its disposition.

3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

5. Review waste management requirements for each trade.

1.06 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.

4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.

2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.

3. Total cost of disposal (with no waste management).

4. Revenue from salvaged materials.

5. Revenue from recycled materials.

6. Savings in hauling and tipping fees by donating materials.

7. Savings in hauling and tipping fees that are avoided.

8. Handling and transportation costs. Include cost of collection containers for each type of waste.

9. Net additional cost or net savings from waste management plan.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.01 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.

2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.02 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until installation.

4. Protect items from damage during transport and storage.

5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

3.03 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: Refer to www.wbdg.org/tools/cwm.php for information on available recycling receivers and processors.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

4. Store components off the ground and protect from the weather.

5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.04 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Salvage non-reinforced concrete ("urbanite") for possible reuse in landscaping. Coordinate with Design Team for minimum size requirements.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.

2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

G. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.

I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

J. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

K. Plumbing Fixtures: Separate by type and size.

L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

M. Lighting Fixtures: Separate lamps by type and protect from breakage.

N. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

O. Conduit: Reduce conduit to straight lengths and store by type and size.

3.05 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood

C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.06 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 01 74 23

CONSTRUCTION INDOOR AIR QUALITY

PART 1 - GENERAL

1.01 SUMMARY

A. This Section describes construction indoor air quality (IAQ) goals and includes administrative and procedural requirements for the development and execution of a construction air quality management plan both during construction and before occupancy.

B. Related Sections:

1. Section 01 33 00 – Submittal Procedures.

2. Section 01 50 00 – Temporary Facilities and Controls.

3. Section 01 61 00 – Common Product Requirements.

1.02 IAQ MANAGEMENT SUMMARY

A. Prevent indoor air quality problems resulting from the construction process, to sustain long term installer and occupant health and comfort.

B. Protect the ventilation system components during construction and clean contaminated components after construction is complete.

C. Control sources of potential IAQ pollutants by controlling selection of materials and processes used in project construction.

D. Develop and implement an IAQ management plan during construction phase as follows:

1. During construction meet or exceed the recommended Control Measures of the SMACNA IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.

2. Protect stored on-site or installed absorptive materials from moisture damage.

3. If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MREV) of 8 shall be used at each return air grille, as determined by ASHRAE 52.2. Replace all filtration media immediately prior to occupancy.

4. Prohibit smoking inside the building and within 25-feet of building entrances once the building is closed.

E. Develop and implement an IAQ management plan for the pre-occupancy phase as follows:

1. Option 1 – Flush Out:

a. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000-cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60-deg. F. and relative humidity no higher than 60-percent.

b. If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500-cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30-cfm/sq. ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of 3-hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000-cu. ft./sq. ft. of outside air has been delivered to the space.

2. Option 2 – Air Quality Testing:

a. Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with USEPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air and as additionally detailed in the LEED for Schools Reference Guide.

b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded.

Contaminant	Maximum Concentration
Formaldehyde	50 parts per billion
Particulates (PM10)	50 micrograms per cubic meter
Total Volatile Organic Compounds (TVOC)	500 micrograms per cubic meter
* 4-Phenylcychlohexene (4-PCH)	6.5 micrograms per cubic meter
Carbon Monoxide (CO)	9 parts per million and no greater than 2 parts per million above outdoor levels
**This test is only required if carpets and fabrics with styrene butadiene rubber (SBR) latex backing material are installed as part of the base building systems*	

c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from the same locations as in the first test.

d. The air sample testing shall be conducted as follows:

1) All measurements shall be conducted prior to occupancy, but during normal occupied hours and with the building ventilation system normal daily start time, and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.

2) The building shall have all interior finishes installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Non-fixed furnishings, such as workstations and partitions are encouraged, but not required to be in place for the testing.

3) The number of sampling locations will vary depending upon the size of the building and number of ventilation systems. For each portion of the building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000-sq. ft. or for each contiguous floor area, whichever is larger, and include areas with the least ventilation and greatest presumed source strength.

4) Air samples shall be collected between 3- and 6-feet from the floor to represent the breathing zone of occupants and over a minimum 4-hour period.

1.03 SUBMITTALS

A. IAQ Management Plan for the construction and pre-occupancy phases of the project.

B. Photographs documenting construction IAQ management measures implemented during construction such as duct protection measures and measures to protect on-site stored or installed absorptive materials from moisture.

C. Cut sheets of filtration media used during construction and installed immediately prior to occupancy with MERV values highlighted.

1.04 CONSTRUCTION AIR QUALITY MANAGEMENT PLAN

A. Develop a Draft Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows:

1. During construction meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction 1995, Chapter 3.

2. Protect stored on-site or installed absorptive materials from moisture damage.

3. Conduct a minimum two-week long building flushout after construction ends and prior to occupancy.

B. The SMACNA IAQ Guidelines for Occupied Buildings under Construction provides an overview of air pollution associated with construction, control measures, construction process management, quality control, communicating with occupants, and case studies. These guidelines can be accessed at www.smacna.org. Chapter 3 of the SMACNA Guidelines recommends Control Measures in five areas: HVAC protection, source control, pathway interruption, housekeeping, and scheduling. Review the applicability of each Control Measure and include those that apply in the Draft IAQ Management Plan.

1. HVAC Protection: Shut down the return side of the HVAC system whenever possible during heavy construction. If the system must remain operational during construction include the following strategies that apply:

a. Fit the return side of the HVAC system with temporary filters with a Minimum Efficiency Reporting Value (MERV) of 8.

b. Isolate the return side of the HVAC system from the surrounding environment as much as possible (e.g., place all tiles for the ceiling plenum, repair all ducts and air handler leaks).

c. Damper off the return system in the heaviest work areas and seal the return system openings with plastic.

d. Upgrade the filter efficiency where major loading is expected to affect operating HVAC system.

e. Clean permanent return air ductwork per National Air Duct Cleaning Association standards upon completion of all construction and finish installation work.

f. Install new clean media just prior to substantial completion and occupancy that has a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999.

2. Source Control: Propose the substitution of non-toxic formulations of materials that are generally the responsibility of the contractor such as caulks, sealants, and cleaning products.

3. Pathway Interruption: Prevent contamination of clean spaces. Include the following strategies that apply:

a. Use 100% outside air ventilation (when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30% and 60%) with air exhausted directly to the outside during installation of finishes and other VOC emitting materials.

b. Erect some type of barrier between work areas or between the inside and outside of the building to prevent unwanted airflow from dirty to clean areas.

4. Housekeeping: Reduce construction contamination in the building prior to occupancy through HVAC and regular space cleaning activities.

a. Store building materials in a weather tight, clean area prior to unpacking for installation.

b. Check for possible damage to building materials from high humidity.

c. Clean all coils, air filters, and fans before testing and balancing procedures are performed.

5. Scheduling: Specify construction sequencing to reduce absorption of VOC's by materials that act as sinks or contaminant sources. Complete application of wet and odor-emitting materials such as paints, sealants, and coatings before installing sink materials such as ceiling tiles, carpets, insulation, gypsum products, and fabric-covered furnishings are installed.

a. Protect stored on-site or installed absorptive materials from exposure to moisture through precipitation, plumbing leaks, or condensation from the HVAC system to prevent microbial contamination.

b. Conduct a two-week building flush-out with new filtration media at 100% outside air after construction ends and prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999. Replace filtration media used during flush-out prior to occupancy.

C. Draft IAQ Management Plan Review Meeting: Once the Owner and Architect have reviewed the Draft IAQ Management Plan and prior to construction at the site, schedule and conduct a meeting to review the Draft IAQ Management Plan and discuss procedures, schedules and specific requirements for IAQ during the construction and pre-construction phases of the building. Discuss coordination and interface between the Contractor and other construction activities. Identify and resolve problems with compliance to the requirements. Record minutes of the meeting and identify all conclusions reached and matters requiring further resolution.

1. Attendees: The Contractor and related Contractor personnel associated with the work of this section, including personnel to be in charge of the IAQ management program, Architect, Owner and such additional personnel as the Architect or Owner deem appropriate.

D. Final IAQ Management Plan: Make any revisions to the Draft IAQ Management Plan agreed upon during the meeting identified in item (C) above and incorporate resolutions agreed to be made subsequent to the meeting. Submit the revised plan to the Owner and Architect for approval within 10 calendar days of the meeting.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 IMPLEMENTATION OF IAQ MANAGEMENT PLAN

A. Manager: The Contractor shall designate an on-site party (or parties) responsible for instructing workers and overseeing and the IAQ Management Plan for the Project.

B. Progress Meetings: Construction related IAQ procedures shall be included in the pre-construction and construction progress meeting agendas.

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

D. Instruction: The Contractor shall provide on-site instruction of the IAQ procedures and ensure that all participants in the construction process understand the importance of the goals of the IAQ Management Plan.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for the following items of the Contract Closeout:

1. Instructions of Owner's personnel.

2. Service and maintenance contracts.

3. Preparation for final inspection.

4. Damage and restoration.

5. Remedial work.

B. Comply with the requirements of the General Conditions and Supplementary Conditions, and the individual Specification Sections for administrative procedures for closing out the work.

C. Related Sections:

1. Operation and maintenance data is specified in Section 01 78 23.

2. Project record documents are specified in Section 01 78 39.

1.02 OPERATION TESTS

A. Conduct operational tests as required to demonstrate that all systems have been completed and are in compliance with all requirements.

B. Furnish a written record of test results using recording type instruments where applicable and as directed.

1.03 INSTRUCTION OF THE OWNER'S PERSONNEL

A. Where specified, furnish qualified personnel for on the job instruction of the Owner's operating and maintenance personnel.

B. Where possible, furnish instruction, including special start-ups and running time, prior to occupancy of the building, including special start-ups and running time, at no additional expense to the Owner.

C. Hours of Training:

1. Where a designated number of hours of training are stipulated for training Owner's personnel in either operation or maintenance of building systems, the designated time allotted for training shall be for time students are present. Instruction transportation time shall be in addition to the allotted time.

2. Where hours of training is not stipulated, the minimum duration of training shall be as required for the instructor to demonstrate both proper operation and maintenance for each building system, for which instruction is specified.

D. Location of Training: Conduct training at the Project.

E. Schedule of Training: Conduct training during normal business hours. Schedule date and time of training at the convenience of the Owner. Training shall be completed within 30-days of the Date of Substantial Completion.

1.04 SERVICE AND MAINTENANCE CONTRACTS

A. Compile, review, and submit specified service and maintenance contracts as specified for warranties and bonds.

1.05 PREPARATION FOR FINAL INSPECTION

A. Perform final cleaning as specified in Section 01 74 00.

B. Assemble warranties, service and maintenance contracts, operating and maintenance instructions, and other items as specified, and submit to the Architect.

C. Remove temporary tapes, wrapping, coatings, paper labels, and other similar items. Dust, mop, wash, or wipe exposed and semi-exposed surfaces.

D. At the Contractor's request, the Architect and Owner's Representative will attend a pre-final detailed Project review, to allow the Contractor to gather the majority of punch list items while the subcontractors are still on the Project. Provide a typewritten list of all items remaining to be completed or corrected; list by room number and item number. Segregate plumbing, HVAC, and electrical on separate lists.

E. At the Contractor's request, the Architect and Owner's Representative will make a final Project review when the items in the pre-final punch list have been completed and after final cleanup, operation tests and the like have been performed.

F. When the Architect and Owner's Representative determines that the Project is substantially complete and that final punch list items are completed, a final Project Inspection Report shall be executed.

G. Upon execution of the Final Project Inspection Report, record and pay for Notice of Completion and furnish copies to the Owner's Representative and the Architect.

1.06 RESTORATION OF DAMAGED WORK

A. Restore or replace damaged materials and finishes caused by movement of equipment or other operations as specified or directed by the Architect, at no additional cost to the Owner.

B. Restoration shall be equal to the original work, and finishes shall match the appearance of existing adjacent work.

1.07 REMEDIAL WORK

A. Replace work due to faulty workmanship or materials at no additional cost to the Owner.

B. Coordinate work with the Owner's Representative and perform at such time and manner to cause minimal interruption and inconvenience to the Owner's operations.

1.08 EXTRA MATERIALS

A. Where specified, provide extra materials in the quantities and manner specified.

B. Delivery and certification of extra materials shall be prerequisite to Substantial Completion.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.

2. Emergency manuals.

3. Operation manuals for systems, subsystems, and equipment.

4. Product maintenance manuals.

5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Submittal procedures are specified in Section 01 33 00.

2. Closeout procedures are specified in Section 01 77 00.

3. Project record documents are specified in Section 01 78 39.

4. Refer to Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the work in those Sections.

1.02 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

b. Enable inserted reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30-days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

B. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15-days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15-days of receipt of Architect's comments and prior to commencing demonstration and training.

2. Authorization for final payment will not be made prior to final acceptance of the Manual.

PART 2 – PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.

2. List of systems.

3. List of equipment.

4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.02 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.

2. Table of contents.

3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.

2. Name and address of Project.

3. Name and address of Owner.

4. Date of submittal.

5. Name and contact information for Contractor.

6. Name and contact information for Architect.

7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.

8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.03 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.

2. Emergency instructions.

3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.

2. Flood.

3. Gas leak.

4. Water leak.

5. Power failure.

6. Water outage.

7. System, subsystem, or equipment failure.

8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.

2. Shutdown instructions for each type of emergency.

3. Operating instructions for conditions outside normal operating limits.

4. Required sequences for electric or electronic systems.

5. Special operating instructions and procedures.

2.04 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.

2. Performance and design criteria if Contractor has delegated design responsibility.

3. Operating standards.

4. Operating procedures.

5. Operating logs.

6. Wiring diagrams.

7. Control diagrams.

8. Piped system diagrams.

9. Precautions against improper use.

10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.

2. Manufacturer's name.

3. Equipment identification with serial number of each component.

4. Equipment function.

5. Operating characteristics.

6. Limiting conditions.

7. Performance curves.

8. Engineering data and tests.

9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.

2. Equipment or system break-in procedures.

3. Routine and normal operating instructions.

4. Regulation and control procedures.

5. Instructions on stopping.

6. Normal shutdown instructions.

7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.

9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.05 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.

2. Manufacturer's name.

3. Color, pattern, and texture.

4. Material and chemical composition.

5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.

2. Types of cleaning agents to be used and methods of cleaning.

3. List of cleaning agents and methods of cleaning detrimental to product.

4. Schedule for routine cleaning and maintenance.

5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.06 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.

3. Identification and nomenclature of parts and components.

4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.

2. Troubleshooting guide.

3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.

5. Aligning, adjusting, and checking instructions.

6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 – EXECUTION

3.01 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

2. Comply with requirements of newly prepared record drawings in Section 01 78 39.

G. Comply with Section 01 77 00 for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 01 78 36

WARRANTIES

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section specifies general administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

B. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.

C. Specific requirements for warranties for the work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions 02 through 48.

D. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

E. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.02 DEFINITIONS

A. Standard Product Warranties are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.03 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

E. The Owner reserves the right to refuse to accept work for the Project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.04 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the Architect.

1. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within fifteen days of completion of that designated portion of the work.

B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner's Representative for approval prior to final execution.

C. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual. Use warranty form in Section 01 78 37.

D. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-inch by 11-inch paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name, of the product, and the name, address and telephone number of the installer.

2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the Project title or name, and the name of the Contractor.

3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS

Not Used.

PART 3 – EXECUTION

Not used.

END OF SECTION

SECTION 01 78 37

FORM OF WARRANTY

WARRANTY FOR _____.

We hereby warrant that all materials and equipment for the _____ that we have provided at _____ are new, unless otherwise specified, and that all work is of good quality, free from faults and defects and in conformance with the Contract Documents. Work not conforming to these requirements, including "equals" not properly approved and authorized, will be considered defective.

If within one year after the Date of Substantial Completion of the work or within one year after acceptance by the Owner of designated equipment, or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, a portion of the work is found to be defective or not in accordance with the Contract Documents, we agree to correct it promptly after receipt of a written notice from the Owner to do so; unless the Owner has previously issued a written acceptance of such condition. This obligation shall survive termination of the Contract.

If we fail to commence compliance with the above paragraph within 7 calendar days after receipt of written notice from the Owner to do so, or fail to pursue such compliance with diligence we, jointly and severally, do hereby authorize the Owner to have said defective work and damages repaired or replaced and made good at our sole expense, including compensation for the Owner's consultants' additional services made necessary by such default, and we will honor and pay the costs and charges for it together with interest at the maximum rate then permitted by governing obligations, and if the Owner brings action to enforce this warranty, we agree to pay the Owner's reasonable attorney's fees incurred in connection therewith. This warranty is for _____ years.

Signed _____
(subcontractor's name, address, license number, and date of signing)

Countersigned _____
(Contractor's name, address, license number, and date of signing)

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.

2. Record Specifications.

3. Record Product Data.

4. Miscellaneous record submittals.

B. Related Sections:

1. Submittal procedures are specified in Section 01 33 00.

2. Closeout procedures are specified in Section 01 77 00.

3. Operation and maintenance data is specified in Section 01 78 23.

1.02 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints.

1) Submit record digital data files.

2) The Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of scanned record prints.

2) Include each drawing whether or not changes and additional information were recorded.

B. Record Specifications: Submit Annotated PDF electronic files of Project Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities.

1. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 – PRODUCTS

2.01 RECORD DRAWINGS.

A. Record Prints: Maintain one set of marked-up paper copies of the contract drawings and shop drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Accurately record information in an acceptable drawing technique.

c. Record data as soon as possible after obtaining it.

d. Record and check the markup before enclosing concealed installations.

e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to the drawings.

b. Revisions to details shown on drawings.

c. Depths of foundations below first floor.

d. Locations and depths of underground utilities.

e. Revisions to routing of piping and conduits.

f. Revisions to electrical circuitry.

g. Actual equipment locations.

h. Duct size and routing.

i. Locations of concealed internal utilities.

j. Changes made by Change Order or Construction Change Directive.

k. Changes made following Architect's written direction.

l. Details not on the original Contract Documents.

m. Field records for variable and concealed conditions.

n. Record information on the work that is shown only schematically.

3. Mark the Contract Documents and shop drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the work at same location.

5. Mark important additional information that was either shown schematically or omitted from original drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers and similar identification where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw and add details and notations where applicable.

3. Refer instances of uncertainty to Architect for resolution.

4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

5. Refer to Section 01 33 00 for requirements related to use of Architect's digital data files.

6. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Format: Annotated PDF electronic file with comment function enabled.

2. Identification:

a. Project name.

b. Data.

c. Designation "PROJECT RECORD DRAWINGS".

d. Name of Architect.

e. Name of Contractor.

2.02 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that specified, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials and equipment furnished, including substitutions and product options selected.

3. Record the name of manufacturer, supplier, installer and other information necessary to provide a record of selections made.

4. For each principal product, indicate whether record product data has been submitted in operation and maintenance manuals instead of submitted as record product data.

5. Format: Submit record Specifications as annotated PDF electronic file or scanned PDF electronic files of marked-up paper copy of Specifications.

2.03 RECORD PRODUCT DATA

A. Preparation: Mark product data to indicate the actual product installation where installation varies substantially from that indicated in product data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, record Specifications and record drawings where applicable.

B. Format:

1. Submit record product data as annotated PDF electronic file or scanned PDF electronic files of marked-up paper copy of product data.

a. Include record product data directory organized by Specification Section number and title, electronically linked to each item of record product data.

2.04 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file or scanned PDF electronic files of marked-up miscellaneous record submittals.

PART 3 – EXECUTION

3.01 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION

SECTION 01 90 00

GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section includes administrative and procedural requirements and a detailed description of the commissioning process.

B. Commissioning is intended to achieve the following objectives:

1. Verify the Owner's Project Requirements (OPR) are developed and incorporated into the design.

2. Verify the Basis of Design (BoD) reflects the OPR and is used in the design.

3. Verify the submittals for commissioned systems meet the requirements defined in the Basis of Design, Specifications, and Construction Documents.

4. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and that they receive adequate operational checkout by installers.

5. Verify and document that performance of equipment and systems is proper for the application and meets the Owner's operational requirements.

6. Verify that Operations and Maintenance (O&M) Manuals are complete.

7. Verify that the Owner's operating personnel are trained in accordance with the Specifications.

1.02 COORDINATION

A. The Commissioning Team includes, as applicable to the Project:

1. The Owner (or owner's representative)

2. Commissioning Authority (CA). CA responsibilities are specified in Section 01 91 14.

3. Architect and Design Engineers (A/E Team)

4. Construction Manager (CM)

5. Project Manager (PM)

6. General Contractor (GC)

7. Sub-contractors (Subs)

8. Building operator (Operator), Maintenance Superintendent

B. Items listed below require coordination between members of the Commissioning Team. Details regarding these items are specified elsewhere in this Section. The activities listed below shall be successfully completed prior to Substantial Completion. Seasonal Tests deemed to be required shall not be a reason to delay Substantial Completion.

1. Integrate commissioning activities into the master schedule. Work with the CA to ensure that commissioning activities are properly shown.

2. Equipment Startup: Utilize Startup Plans to coordinate equipment startup, manufacturers' testing, and other required testing to minimize duplication of work. Notify CA 10-days prior to Startup.

3. Prefunctional Tests: Utilize Prefunctional Tests provided by the CA, making note of any incomplete and deficit tests. Notify CA 10-days prior to Prefunctional Tests. Submit to the CA as soon as complete.

4. Testing, Adjusting, and Balancing (TAB): TAB work shall begin by the appropriate contractor after completion of and approval of Startup Plan and Prefunctional Tests by the Commissioning Authority (CA). Notify CA 10-days prior to testing, adjusting, and balancing so that the CA may witness the processes. Submit TAB report to the CA as soon as it is completed.

5. Submittal of Operations and Maintenance Documentation: O&M Manuals, sequence of operations, suggested maintenance and preventative maintenance activities, and list of recommended spare parts shall to be submitted to CA for approval prior to Functional Testing.

6. Functional Testing: Coordinate Functional Testing with the CA to witness and document testing. Completion and acceptance by CA of Prefunctional Tests, TAB reports, and Operations and Maintenance Manuals are required prior to scheduling Functional Testing. Submit these reports to the CA a minimum of 14-days prior to scheduling Functional Tests.

7. Training of building users and operations personnel: Submit training agenda(s) to CA for review and approval. Provide training to building users and operations personnel at the level necessary to impart the operational knowledge relevant to each group.

1.03 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CA and Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CA and Contractor for use in developing the Commissioning Plan, systems manual, and operation and maintenance training plan.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Attend commissioning team meetings held on a variable frequency basis.

2. Integrate and coordinate commissioning process activities with construction schedule.

3. Review and accept construction checklists as work is completed and provide to the CA as soon as completed.

4. Review and accept commissioning process test procedures provided by the CA.

5. Complete commissioning process test procedures.

6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

7. Cooperate with the CA for resolution of issues recorded in the Issues Log.

8. Provide O&M Manuals and other supporting documentation described in other sections necessary for the CA to compile Systems Manual for Owner.

9. Provide Training Agenda to CA covering topics necessary to impart information to the building users, maintenance staff, and Owner.

10. Provide training to building users, maintenance staff, and Owner.

1.05 CA'S RESPONSIBILITIES

A. As specified in Section 01 91 14.

1.06 DEFINITIONS

A. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

B. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Commissioning (Cx) Process: A systematic process which verifies that the building systems perform as intended. The commissioning process coordinates system documentation, equipment startup, control system calibration, testing and balancing, and performance testing and training. LEED Cx also assists in the coordination process to assure design, construction, and post-construction (warranty period) integration proceeds with intentional sequencing and scheduling of Cx requirements.

D. Components, Subsystems, Equipment, and Systems: Where these terms are used together or separately, they shall mean "as-built" components, subsystems, equipment, and systems.

E. Commissioning Authority (CA): An entity identified by the Owner that plans, schedules, and coordinates the Commissioning Team to implement the Commissioning Process. Refer to Section 01 91 14 for CA qualifications and responsibilities.

F. Startup Plan: A written program that documents the equipment's readiness to be completed prior to the equipment's Functional Tests. Manufacturer's startup checklist is part of each Startup Plan. The Startup Plan is prepared by the Contractor and approved by CA. The Checklists are completed by the Contractor and verified by the Commissioning Authority through site visits, inspections, and review of the completed Startup Plan.

G. Prefunctional Tests (PT): A documented set of calibrations and tests designed to verify the systems are configured according to manufacturers' requirements, specifications, and owner's requirements. These tests provide the contractors' assurance that the components and systems are ready for Functional Testing. TAB work is to be completed after all Prefunctional Tests and prior to Functional Testing. Prefunctional Tests are often completed at the same time as the Startup Plan.

H. Functional Test (FT): A documented test of the dynamic functioning and operation of equipment and systems with the goal of verifying that the Design Intent is met. Test procedures are developed and results documented by the Commissioning Authority. Test procedures are completed by the Contractor. Functional Testing generally begins with component calibration and proceeds through verification of equipment and systems integration.

1.07 COMMISSIONING PLAN

A. The Commissioning Plan is an independent document issued by the CA to the Commissioning Team. Where there is a conflict, the Specifications and Contract Documents take precedence over the Commissioning Plan.

B. The Commissioning Plan provides guidance in the execution of the commissioning process. The Commissioning plan outlines the specific inspections and tests that shall be performed as part of the commissioning process for the project and assigns roles and responsibilities. A preliminary copy shall be issued for use during the initial Commissioning Kick-off Meeting. After the Kick-off Meeting, the CA shall update and reissue the Commissioning Plan as needed.

1.08 COMMISSIONING REQUIREMENTS

A. Fundamental Commissioning of the Building Energy Systems.

1. Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.

a. Commissioning Authority qualifications and responsibilities are specified in Section 01 91 14.

2. The Owner will document the Owner's Project Requirements (OPR). The design team will develop the Basis of Design (BOD). The Commissioning Authority shall review these documents for clarity and completeness. The Owner and design team will be responsible for updates to their respective documents.

3. Develop and incorporate commissioning requirements into the Construction Documents.

4. Develop and implement a commissioning plan.

5. Verify the installation and performance of the systems to be commissioned.

6. Complete a summary commissioning report.

7. Commissioning process activities shall be completed for the following energy-related systems, at a minimum:

a. Heating, ventilating, air-conditioning and refrigeration system (mechanical and passive) and associated controls.

b. Lighting and daylighting controls.

c. Domestic hot water systems.

d. Renewable energy systems, as applicable.

B. Enhanced Commissioning.

1. Prior to the start of the Construction Documents phase, designate an independent Commissioning Authority (CxA) to lead, review and oversee the completion of all commissioning process activities. The CxA shall, at a minimum, perform Tasks 2, 3 and 6. Other team members may perform Tasks 4 and 5.

a. Commissioning Authority qualifications and responsibilities are specified in Section 01 91 14.

2. The Commissioning Authority shall conduct, at a minimum, one commissioning design review of the Owner's Project Requirements (OPR), Basis of Design (BOD) and design documents prior to mid-construction documents phase and back-check the review comments in the subsequent design submission.

3. The Commissioning Authority shall review Contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD. This review shall be concurrent with A/E reviews and submitted to the design team and the Owner.

4. Develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems.

5. Verify that the requirements for training operating personnel and building occupants are completed.

6. Assure the involvement by the Commissioning Authority in reviewing building operation within 10-months after Substantial Completion with O&M staff and occupants. Include a plan for resolution of outstanding commissioning-related issues.

1.09 SYSTEMS TO BE COMMISSIONED

A. The following systems shall be commissioned where applicable:

1. Energy Management and Temperature Control System

2. Sensor Calibration and Accuracy

3. Air Distribution and Ductwork

4. Boiler and Chiller System and Controls

5. General Occupancy Exhaust Fans and Controls

6. Rooftop Packaged Units and Controls

7. Air Handling Units

8. VAV Terminal Units

9. Radiant Gas Heater and Controls

10. Water Heater, Recirculation Pump and Controls

11. Irrigation Controls

12. Hot water heater; recirculation pump and controls

13. HVAC Equipment

14. Energy Management System Commissioning

15. Lighting System and Controls

16. Photovoltaic System

17. Rainwater Catchment System

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

A. Provide testing equipment, tools, and instruments required by the Commissioning Process except data logging equipment. Data logging equipment is provided by the CA.

B. Provide CA with a list of test equipment, serial numbers, and calibration certificates expected to be used in the testing process. Calibration certificates shall be dated within 12-months of when equipment is expected to be used. Lists shall be submitted for approval 30-days prior to Startup and Prefunctional Tests.

C. List of equipment and approved options, means of control and control sequencing, and setpoints shall be provided to CA by each subcontractor responsible for commissioned systems. Lists shall be submitted to Contractor 45-days from Submittal acceptance. Contractor shall submit completed list to CA within 10-days of receipt of lists.

PART 3 – EXECUTION

3.01 MEETINGS

A. Commissioning Kick-off Meeting: A commissioning scoping meeting shall be held within 60-working days after the Notice to Proceed. Attendance is mandatory for the entire Commissioning Team.

B. Other Meetings. The CA shall schedule other meetings, generally in conjunction with regularly scheduled site meetings. Meetings shall cover coordination, deficiency resolution, and planning issues.

3.02 COMMISSIONING SUBMITTALS

A. The CA shall request that specific equipment submittals be copied or routed to the CA for review and comment. Generally, all equipment that is subject to commissioning shall be required to be submitted to CA.

B. Commissioning submittal requests shall be integrated into the normal submittal process and protocol of the construction team.

C. The CA shall review and comment on submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functionality of the equipment, and as to the adequacy for developing test procedures.

3.03 SITE INSPECTIONS

A. Relevant subcontractors shall accompany the commissioning authority on up to 3 construction site visits prior to Functional Testing.

B. The Contractor shall correct deficiencies found during site visits within 7 days of receiving a Corrective Action Report (Issues Logs).

3.04 STARTUP PLANS

A. Undertake a full startup checkout of each piece of equipment. The Startup testing must be successfully completed prior to formal Functional Testing of that system.

B. Equipment shall not be “temporarily” started until it has been started up in accordance with the manufacturer’s written startup procedures as per the Startup plan.

C. Startup Plans: Prepare a Startup Plan for each piece of equipment listed in this Section and submit it for approval by the CA within 45-days of receiving approved equipment submittals (and at least 30-days prior to scheduled Startup). Startup Plans shall consist of:

1. The manufacturer’s standard written startup procedures per the manufacturer’s installation manuals, with check boxes by each procedure and a signature block at the end.

2. Equipment Manufacturer’s Installation, Operating & Maintenance instructions.

3. A schedule for the equipment installation, contractor startup, manufacturer’s startup, and other tests required by the specifications. Schedule shall state when Startup and completion is expected.

4. Field checkout sheets normally used by the sub-contractor.

5. Forms used by the sub-contractor to document tests required in the specifications.

6. The checklists for mechanical systems include sensor and actuator calibration.

D. The subcontractors shall complete the documentation per paragraph C during the startup of the equipment and submit the completed documentation to the CA prior to the scheduled Functional Testing. The CA shall accept or reject each Startup Plan submittal, noting each item with one of the following:

1. NO EXCEPTIONS NOTED

2. IMPLEMENT EXCEPTIONS NOTED

3. REVISE AND RESUBMIT

4. REJECTED

3.05 PREFUNCTIONAL TESTING REQUIREMENTS

A. Notify the CA 14-days prior to beginning Prefunctional Testing.

B. Complete checklist of Prefunctional Tests, noting any deficits in writing.

C. Submit the completed Prefunctional Tests to the CA.

D. Prefunctional tests may be done in conjunction with Startup procedures, though not to the exclusion of either the Startup procedure or the Prefunctional Tests.

3.06 TEST AND BALANCE REQUIREMENTS

A. Test and Balance (TAB) work shall start after Startup and Prefunctional Tests are completed and accepted by CA.

B. Notify CA 10-days prior to scheduled TAB work.

C. TAB work shall be conducted with “loaded” filters that are specified for occupancy.

D. Submit TAB report to CA for approval as soon as completed.

3.07 FUNCTIONAL TESTING REQUIREMENTS

A. Complete the following prior to Functional Testing:

1. Coordinate with the Commissioning Authority to be present during Functional Testing.

2. A minimum of 14-day notice to the CA is required prior to the scheduling of the Functional Testing.

3. Completion and acceptance of the Startup Plan and Prefunctional Tests by CA.

4. Correction of deficiencies identified during Startup and Prefunctional Tests. These will be identified through Issues Logs provided by CA.

B. Provide CA with access to the record documents.

C. Recording of pretest and final set points.

D. Use only the certified testing equipment provided in the list given to the CA.

E. Undertake Functional Testing after the listed activities are completed.

F. Perform Functional Testing under the observation of the Commissioning Authority who shall record the results of the Functional Test procedures.

G. Perform specified tests according to approved testing procedures and the following Control Signal Manipulation requirements:

1. Verify and test performance using actual conditions whenever possible.

2. Simulate conditions by imposing an artificial load when it is not practical to test under actual conditions and when written approval for simulated conditions is received from Commissioning Authority. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After test, return settings to normal operating conditions.

3. Alter set points when simulating conditions is not practical and when written approval to do so is received from Commissioning Authority.

4. Overwrite sensor values with a signal generator when actual or simulated conditions and altering set points are not practical. Do not use the sensor to act as the signal generator to simulate conditions or overwrite values.

H. The Commissioning Authority shall review and approve Functional Testing results. Deficiencies found during testing shall be corrected by the Contractor within 7-days of receiving an Issues Log from the CA. Deficiencies shall be retested without cost to the owner until accepted by the Commissioning Authority. Where there is a dispute over a deficiency, the Engineer shall be the final authority.

I. Problem Solving: The CA may recommend solutions to problems found, however the burden of responsibility to solve, correct, and retest problems is with the contractor.

J. All testing, retesting, and acceptance of Functional Testing shall be completed prior to Substantial Completion.

3.08 OPERATIONS AND MAINTENANCE DOCUMENTATION

A. Furnish a completed copy of the Operations and Maintenance Instructions to the CA. Follow the normal submittal procedure for this submittal. The CA shall accept or reject the submittal, noting it as one of the following:

1. NO EXCEPTIONS TAKEN

2. REVISE, NO RESUBMISSION REQUIRED

3. REVISE AND RESUBMIT

4. REJECTED

B. Finalize and make corrections to Record Documents as noted by the CA prior to Functional Testing.

3.09 OPERATIONS AND MAINTENANCE TRAINING

A. Coordinate and schedule demonstration & training for all commissioned systems.

B. Provide written agenda for targeted audience for approval by CA. Agenda to be submittal a minimum of 7-days prior to scheduled training.

C. Coordinate training of commissioned equipment with the CA who shall oversee and approve its content and adequacy.

D. Coordinate training with the owner who may provide videotaping services.

E. Separate training may be required for building users, maintenance staff, and owners.

F. In addition to these general requirements, specific training requirements for commissioned equipment may be specified in Divisions 22, 23 and 26.

3.10 PROJECT CLOSEOUT

A. The commissioning process shall be completed when the systems operate according to the Owner's Design Intent and the Contract Documents, as determined by the CA.

B. The commissioning process may continue past Substantial Completion of the Project, until all non-compliance issues have been resolved. Testing, retesting, and acceptance of Functional Testing (with exception of seasonal and warranty-period tests as identified in the Commissioning Plan) shall be completed prior to Final Completion.

3.11 COST OF RETESTING

A. Costs for retesting beyond one retest shall be the responsibility of the Contractor if the CA determines that the Contractor is responsible for the deficiency. Where disputes occur, the Engineer shall make the final determination.

B. For a deficiency identified during functional retesting but not included in the approved Startup Plan, the Engineer shall direct and the Contractor shall retest the equipment until the CA accepts test results.

C. Retesting shall not be considered a reason for a claim of delay or for a time extension by the contractor.

D. Additional costs incurred by the CA for retesting systems which used unapproved Startup procedures or completed inadequately during Prefunctional Tests may be charged to the Contractor.

3.12 DEFERRED TESTING

A. Equipment requiring seasonal testing to properly assure equipment operations, as determined by the CA, shall require the Contractor to perform Functional Testing at a later time. At no time shall the testing extend beyond the warranty period.

B. Unforeseen Deferred Tests: Checks or tests not completed due to the required occupancy condition, or other condition may be delayed upon approval of the Engineer.

C. Warranty Review: CA may require contractor to perform additional testing when results from the Warranty Review suggest components, systems, or system's integration is failing during the warranty period.

END OF SECTION

SECTION 01 91 00

COMMISSIONING

PART 1 GENERAL

1.01 SCOPE OF SPECIFICATION

At the onset of the project the Stanford Project Manager

A. Will review the scope of the project to determine if commissioning (Cx) will be done by the General Contractor (GC) or a 3rd party commissioning agent (CxA). If the GC is selected to take on commissioning responsibilities, the Cx agent's scope of work will be transferred to the GC. General requirements for the commissioning of the listed systems, is to demonstrate that each system has been provided and installed in strict accordance with the Contract Documents and that each system operates as specified to meet end user needs. Commissioning is ultimately the responsibility of the GC and associated subcontractors. The CxA will be under direct contract with Stanford to check on commissioning status and verify that contractors have commissioned systems completely.

The following systems (and all integrated equipment / controls) are to be included in the Commissioning Scope of Work. Additional systems may be added as applicable.

Plumbing / Process Piping:

1. Domestic water systems
2. Storm Drainage systems Roof Storm and Overflow Drainage Systems
3. Sanitary Waste System
4. Natural Gas
5. Fuel Oil System
6. Lab Waste & Drain System
7. Process Gas systems (O2, CO2. H2, N2 and LN2)
8. Process Vacuum System
9. CDA System
10. RO / DI Water System
11. Reclaimed Water Systems

Mechanical

1. Chilled Water System (including controls, piping, pumps and VFD's)
2. Heating Hot Water System (including heat exchanger, pumps, controls and VFD's)
3. Process Cooling Water (Controls, Piping, Heat Exchangers, Pumps, VFD's)
4. Chemical Treatment
5. Steam and Steam Condensate System
6. Air handling systems
7. HVAC Terminal units
8. Packaged HVAC equipment
9. Radiant Heating System
10. Exhaust Systems
11. Clean room Testing, Adjusting and Balancing
12. Building Automation System (Controlled Devices, Control Loops, System Integration and Trending)

Electrical

1. Electrical Distribution (Main Service, Switchboard, MCC's & Panels)
2. Grounding System
3. Emergency Power System (Generator and ATS)
4. Lighting Control System (Occupancy Sensors, Daylight Sensors)
5. Exterior Lighting System
6. Photo-Voltaic System

Life Safety Systems

1. Fire Detection System
2. Fire Suppression/Protection Systems
3. Emergency Egress Lighting
4. Smoke Control /Smoke Dampers
5. Gas Detection Systems (CO /TGO)
6. Fire Shutters/Smoke Curtains

Process Labs
1. Fume Hoods
2. Safety Showers and Eyewashes
3. Controlled Environment Rooms

Conveyance and Lifting Systems
1. Elevator
2. Motor Operated Roll-up Doors
3. Overhead Cranes
4. Loading Dock Levelers

B. The design review shall provide the following deliverables:

1. Review of the drawings and specifications – for design / operation / commissionability of equipment and systems.
2. Review of the specifications for construction quality-check requirements for each system.
3. Develop the turnover package (TOP) requirements with the GC and client, which include the number of systems and the boundaries for the commissioned systems.

C. Commissioning shall include Functional Performance Tests: Conduct a systematic performance test of each individual element, subsystem, and total system to a predefined test method with the option of the attendance of the Architect/Engineer and / or Owner's representative. The testing shall include all controls, alarms, and systems integral to and/or necessary for the proper function of the facility, and will also include a summary commissioning report.

D. Corrections and Adjustments: Sub Contractors shall record, correct and adjust all deficiencies in operation noted during testing and then perform a retest. Any additional costs for retesting will be the responsibility of the subcontractors.

E. Acceptance: Project substantial completion will not be accepted until all building systems have been successfully commissioned, and system performance demonstrated to and signed off by the Owner.

1.02 RELATED SECTIONS

A. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

B. Other Divisions: Technical Specifications on Specific System Performance.

1.03 DEFINITIONS

A. Commissioning: The systematic process of ensuring, by verification and documentation that all building systems perform interactively, in accordance with the Design Documents and the Owner's operational needs.

B. Commissioning Team: DPM, BGM, SEM, General Contractor (GC), Commissioning Agent (CxA), Installing Subcontractors, Testing and Balancing Agency and A/E.

C. Functional Performance Test: Testing of an entire system to ensure that the whole system performs as specified, this testing would typically include any system challenges, e.g. for an HVAC system performance testing of the system would include testing the system airflow with simulated dirty filters.

1.04 INSTALLER SUBMITTALS (INFORMATIONAL): Follow Section 01 33 00 Submittal Procedures.

A. Work Schedules: Detailed work schedules at least thirty (30) days before beginning work of this Section.

B. Startup Procedures: Detailed startup procedures based on manufacturer's recommendations for each system component at least thirty (30) days before startup work.

C. Work Plans: Detailed plans showing each step of the work of this section at least thirty (30) days before beginning this work. Submit names of individuals, company affiliation, and who will be performing the work, and who are managing the work.

D. Certification of Work Conditions: Certification that conditions required to start each item of work is completed. Submit certification at least five (5) days prior to beginning work on the subject system.

E. Field Reports: Provide format for final turn over documentation.

1.05 QUALITY ASSURANCE: Comply with:

A. Associated Air Balance Council (AABC). National Standards for Total System Balance

B. National Environmental Balancing Bureau (NEBB). Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

C. Air-Conditioning and Refrigeration Institute (ARI) Standards.

D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards for commissioning.

E. American Society of Mechanical Engineers (ASME) Standards.

F. National Fire Protection Association (NFPA) Standards including, but not limited to, NFPA 70E, National Electrical Code (NEC).

G. SMACNA Standards (1995 Version)

1.06 COMMISSIONING TEAM RESPONSIBILITIES

A. OWNER'S REPRESENTATIVE

1. Reviews all costs and provides funding to the team (BGM/SEM submits to DPM)
2. Coordinates work between GC, BGM and SEM.
3. Reviews and approves all Cx Documents (BGM/SEM and DPM Representatives).
4. Final approval of the Cx Plan (BGM / SEM and DPM).
5. BGM/SEM will provide Facility Operations personnel to join in job walks during the construction phase, as well as insuring that their personnel are available during the FPT's, so that they have a better understanding of the new facility.
6. Coordinate attendance at start-up and/or training sessions by operating personnel.

B. Architect/Engineers (A/E)

1. A/E is responsible for responding to requests for information related to contract documents, operational qualification requirements, and/or design intent.

2. A/E is responsible for providing a complete and comprehensive Sequence of Operations. Note that the generation of a project specific method statement is considered necessary to ensure that the commissioning contractor has an understanding of how the system operates, and any potential interactions with other systems.

C. GENERAL CONTRACTOR

1. General Contractor shall provide purchasing, installation, supervision and management services to the project. The GC shall be responsible to ensure all trade contractors under contract to or falling under the responsibility of the GC to perform all quality assurance and testing requirements to the standards established by the project specific construction quality program. The GC will work with subs and equipment vendors to develop Cx plan which includes: factory testing, field verification, installation inspection, system pre functional testing, global systems functional testing and training.

2. The GC shall be responsible for supervising and authorizing work of this Section. The GC shall organize and maintain comprehensive system manuals which shall consist of all documentation described herein, and organized as follows:

    a. Section 1 - General Information with TOP Acceptance Letter from CM, Certificate of Substantial Completion, Copy of Permits
    b. Section 2 – Copy of Specifications, Copy of BOD, Design review reports, As-Built Drawings
    c. Section 3 – Copy of RFI's applicable to the individual trades / systems
    d. Section 4 – Copy of all approved submittals
    e. Section 5 – Copy of all O&M Manuals, list of spare parts, list of scheduled maintenance requirements, warranty information
    f. Section 6 - Installation inspection reports / construction quality test records (FAT/SAT's) along with high-lighted shop drawings, indicating specific sections included in each of the pressure tests), Copy of signed-off punch-lists
    g. Section 7 – Copy of all equipment start-up sheets / reports
    h. Section 8 - Copy of all Functional Performance Tests (Cx Documents)
    i. Section 9 – Training Records
    j. Section 10 – Electronic Copy of the Items in Sections 1 thru 9

3. The GC shall be responsible to collect and verify that all installation checks and start-up procedures have been completed in compliance with the contract documents. This pertains to all equipment, material and devices.

4. GC is responsible to insure that the schedule incorporates all activities and personnel availability, which would allow / facilitate the commissioning of all systems to be complete prior to the project turnover date.

5. GC is responsible to verify that all as-built (record) drawings have been submitted, that they are complete and accurate.

6. GC is responsible to develop each subcontractor's start-up and training schedule, and coordinate these activities with the Owner (BGM). The training sessions are to be supervised by the GC, and they should notify the Owner.

D. INSTALLER (Installing Subcontractor)

1. Provide labor, equipment manufacturers' representatives, consultants, equipment and materials necessary to start-up all equipment within their scope of work and perform the documented testing necessary to demonstrate that the installation meets the specified requirements.

2. Review the commissioning test requirements as specified, and provide any additional test ports or instrumentation required but not shown on drawings, to accomplish performance tests.

3. Provide to the Commissioning Team a detailed commissioning plan and documentation of field calibration of all controls in accordance with the Owner's calibration policies. Documentation shall include dates, set-points, calibration coefficients, control loop verification, start-up reports and any other data required to verify system checkout. Documentation shall be dated and initialed by the field engineer or technician performing the work.

E. COMMISSIONING AGENT (CxA)

1. Review of Design Documents to become familiar with project, not for comments.

2. Participation in LEED certification (if applicable)

3. Review the Cx Plan developed by contractors including the Installation / Verification Documentation, comment to enhance if needed.

4. Review all start-up, factory acceptance tests (FAT), and site acceptance tests (SAT) procedures for each piece of equipment (provided by the installing contractor or vendor). Spot check execution of FAT and SAT and all pressure testing of piping and ductwork systems to ensure contractors are performing tests.

5. Formal walk down per system to verify that installation is completed in accordance with design, code requirements, and per the approved shop drawings, and that all equipment and components have been installed so that they are accessible for maintenance procedures.

6. Planning – the commissioning contractor will provide input into the schedule to ensure that systems are put to work in the correct sequence allowing for interdependencies, and the status of other systems that may affect the ability to complete commissioning.

7. Develop Functional Performance Tests (FPT) to confirm systems are performing as designed.

1.07 INSTALLATION VERIFICATION AND PRE-OPERATIONAL INSPECTION

A. General: Installation Verification activities are ongoing throughout the submittal, purchasing and installation phases by the installation contractor. The objective here is to ensure that the installation is as specified. All materials / equipment that are installed are in accordance with the approved submittals and shop drawings, as well as being in compliance with all codes. Additionally, this ensures that the "As-Built" or "Record" drawings are accurate.

B. CxA's Responsibilities:

1. Develop a specific project scope of work within the commissioning plan. Assist with the definition for turnover packages with the GC/client, which includes the number of systems and the boundary definitions for the commissioned systems.

2. Develop a list of all submitted and approved materials and equipment to aid in field verification.

3. The CxA will assist in the management of and planning and scheduling of all startup and commissioning activities. The CxA will provide input into the schedule to ensure that systems are put to work in the correct sequence, allowing for interdependencies, and will provide the status of other systems that may affect the ability to complete commissioning within the project schedule. Meet with the Commissioning Team members for weekly meetings and status reports.

4. The CxA will create the facility and system specific Functional Performance Tests (FPT's) based on a Sequence of Operations. Review and approve the creation of FAT, SAT, start-up and checkout forms

and oversee all equipment start-up and pressure testing of systems. Formal system walk-down to confirm that the installation is completed to the design and sign off on all testing of components / systems.

5. Develop and compile the commissioning report for each system. Verify that deficiencies are corrected in a timely manner. Document the resolution of all discrepancies and variations on a "Problem and Resolution" report form. Include completed forms in commissioning report. Assemble documentation in a manner acceptable to the Owner. This documentation will then be forwarded to the Owner for final acceptance.

B. Installer's Responsibilities:

1. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.

2. Attend Commissioning progress and coordination meetings. Assist General Contractor (GC) in the development of work schedules relating to commissioning and testing activities in conformance with Contractor's guidelines.

3. Subcontractors are to provide a complete set of coordinated shop drawings, data sheets and check-lists to the GC/CxA which is to be used to document as-built conditions. These documents would be considered a formal documentation of the subcontractors QA/QC program and be reviewed on a monthly basis with the subcontractors for verification as to work in place for progress payment requests.

4. Complete punch-list and observation report items prior to installation verification inspections. Make necessary changes and/or adjustments as required to complete checklist items. These are to be done within a given time frame in order to maintain the project schedule. Note: Installer shall follow the Owner's change control procedures (CCP) and provide documented evidence that Owner's change control procedures are being followed.

5. Review the Cx test requirements and provide any additional test ports or instrumentation required but not shown on drawings, to accomplish performance tests. Manipulate control systems and perform all testing procedures to demonstrate component and system operation for the Commissioning Agent.

6. All documentation shall be provided in an acceptable format and follow QA/QC requirements along with Good Documentation Practices (GDP). At a minimum the documentation shall:

    a. Include project name, number, volume number, and volume title
    b. Be typewritten on 8-1/2 by 11-inch paper suitable for insertion into a three-ring binder.
    c. Pages shall be numbered and centered on the bottom in sequential numerical order (i.e. Page X of Y).
    d. Entries shall be in ink and Initialed and dated by the personnel performing the work.

7. Additional responsibilities: Installer is responsible for verifying and obtaining any third party documentation related to system which may include but is not limited to:
    a. Establish trend logs of system operation
    b. Obtaining/ verifying any third party documentation related to system
    c. Completed electrical transformer / switchgear reports
    d. Completed air / water balance reports
    e. Verification of vibration isolation adjustment and seismic restraints

8. Provide O & M manuals and spare parts lists as specified and required, along with developing a recommended maintenance schedule. The installer along with associated manufacturer's representatives will be responsible for training of facilities operations personnel. Installer training sessions shall provide a detailed analogy of system operation, maintenance and repair. Video taping of these sessions may be required.

1.08 STARTUP AND COMMISSIONING

General: System startup shall commence after installation verification and pre-operational inspections are complete. The objective is to assure that all components and equipment are prepared and started up safely, and in accordance with manufacturer's instructions.

A. General Contractor's (GC's) Responsibilities:

1. Review, coordinate and finalize schedule of Installers' work associated with system startup activities.
2. Coordinate schedule with other Commissioning Team and or specialist manufacturing suppliers to allow for participation as necessary.
3. Review/approve startup procedures.
4. Witness system startup.
5. List any deficiencies found during system startup. Document the resolution of all discrepancies and variations on a "Problem and Resolution" report form. Include completed forms in system manual.
6. Compile startup information and assemble in system manual.
7. Complete all checklists and FPT's for each specific system. Note: Specialized equipment, such as Chillers or compressors will generally have a separate commissioning report from the supplier, this is typically used as a reference, with the "proof of performance" extracted to simplify review. Proof of the unit capacity is usually required in the specification, and typically provided by the manufacturer based on the FAT

B. Installer's Responsibilities:

1. Develop a startup plan and schedule for each system to be commissioned.
2. Coordinate with the GC for schedule development relating to system startup activities.
3. Perform system startup. Coordinate with other Installers as required.
4. Rectify any system or equipment deficiencies found during system startup.
5. Assist Contractor in the development of schedules relating to Operational Qualification (OQ) testing activities.
6. Execute Operational Qualification (OQ) testing activities specified.
7. Complete OQ Data Sheets and checklists.

C. A/E's Responsibilities:

1. Respond to requests for information related to Contract Documents or design intent, startup procedures or requirements.

D. Owner's Responsibilities:

1. Witness all startup activities as desired.
2. Additional discretionary participation as desired.

1.09 Acceptance:

A. Design team will define acceptance criteria for each system.
B. Commissioning Agent will define testing required for acceptance and document testing results.

1.10 CLOSEOUT

A. Commissioning Agent's (CxA's) Responsibilities:

1. Review and sign-off test record sheets in the commissioning report
2. Develop and compile the commissioning report for each system
3. Submit the final report to the Owner.

B. General Contractor's Responsibilities:

1. Witness all OQ activities and attest to satisfactory completion by signing off on functional performance test summary sheets.
2. Additional discretionary participation, as desired.

1.11 OPERATIONAL STAFF TRAINING

A. Operational staff training shall be conducted after all FPT work is completed. The objective is to provide Facilities Operations personnel with the necessary information and instruction to assure that they can efficiently and safely operate and maintain the facility systems at their peak performance levels.

PART 2 EXECUTION

For Functional Performance Testing requirements, include 10% device verification for systems that are not considered critical, i.e. Fan Coils, VAV Boxes, Chilled beams, etc. If there are discrepancies found in the documents provided by the subcontractors that exceed more than 10% failure of devices tested or incorrect documentation, (this percentage is adjustable as to what is acceptable to the Owner) the installing contractor will repair and pay CxA for retesting of failed devices and another 10%.The additional verification cost to be borne by the GC and subcontractor. This would apply, but not limited to the following systems:

- Domestic Water System (Hot and Cold)
- SW&V System
- Storm Drainage System
- Irrigation System
- Natural Gas System
- HVAC – Wet side (CHW, CW, HHW, TCHW, THHW, Steam)
- HVAC Dry side systems
- Radiant Heating System
- Electrical Distribution.
- Lighting Controls System

For systems that are considered critical or essential to the operation of the facility, we recommend that the CxA do 100% inspection and testing. These systems would include, but not limited to the following systems:

- Life Safety Systems (emergency generator, Emergency Lighting, FSD's, Elevators)
- Equipment and systems serving any Laboratories
- BMS Systems
- CO Detection System
- Fuel Oil System
- Atrium Smoke Control System (Including operable doors & windows)
- Fire Detection System*
- Fire Suppression Systems*
- Kitchen Hoods and Fire Suppression Systems*

  * (Performed by SUFMO- CxA to gather testing documentation)

Compensation for Retesting: General Contractor and Sub-Contractors shall compensate Stanford for site time necessitated by incompleteness of systems or equipment at time of Functional Performance Testing. All testing failures which require on-site time for retesting will be considered actual damages to Stanford. All parties under contract with Stanford who are affected by the retesting shall be included in the contract modification.

END OF SECTION

SECTION 02 41 19

SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Selective demolition and removal of portions of the existing building, as indicated and as required to perform the work.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Cutting and patching is specified in Section 01 73 29.

1.02 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be salvaged or to remain the Owner's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and bring to Owner's designated storage area within the building.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then reinstalled in their original locations.

1.03 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the Project site.

1.04 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Proposed dust control measures.

C. Proposed noise control measures.

D. Schedule of selective demolition activities indicating the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

2. Interruption of utility services.

3. Coordination for cutoff, capping, and continuation of utility services.

4. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of Owner’s on-site operations.

5. Coordination of Owner’s continuing occupancy of portions of existing building and of Owner’s partial occupancy of completed work.

6. Locations of temporary partitions and means of egress.

E. Inventory of items to be removed and salvaged, if any.

F. Inventory of items to be removed by Owner, if any.

G. Photographs or videotape, sufficiently detailed, of existing conditions, of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

H. Record drawings at Project closeout. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition work similar to that required for this Project.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction. Comply with noise and dust regulations of authorities having jurisdiction.

C. Pre-Demolition Conference: Conduct conference at the Project site. Review methods and procedures related to building demolition including, but not limited to, the following:

1. Inspect and discuss condition of building to be demolished.

2. Review structural load limitations of existing structure.

3. Review and finalize schedule and verify availability of equipment, personnel, and facilities required.

4. Review areas where existing construction is to remain and requires protection.

5. Review methods for removing materials from the site.

6. Review staging area for materials on the site.

1.06 PROJECT CONDITIONS

A. Owner will occupy portion of the building immediately adjacent to selective demolition areas.

B. Owner assumes no responsibility for actual condition of buildings to be selectively demolished. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Hazardous Materials: It is not expected that asbestos or other hazardous materials will be encountered in the demolition work. If any materials suspected of containing asbestos or other hazardous materials are encountered, do not disturb the materials. Immediately notify the Architect and the Owner. The Owner will arrange to have hazardous materials removed under a separate contract.

D. Storage or sale of removed items or materials on-site will not be permitted.

1.07 SCHEDULING

A. Arrange selective demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities not to be re-used have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.

E. Survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition.

F. Perform surveys as the demolition work progresses to detect hazards resulting from selective demolition activities.

3.02 UTILITY SERVICES

A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and governing authorities.

2. Provide not less than 72-hours notice to Owner if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.

2. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit after bypassing.

3.03 PREPARATION

A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Conduct demolition operations and remove debris to ensure minimum interference with streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.

1. Protect walls, ceilings, floors and other existing finish work that are to remain and are exposed during selective demolition operations.

D. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.04 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.05 SELECTIVE DEMOLITION

A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically. Complete selective demolition work above each floor or tier before disturbing supporting members on lower levels.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly. On-site storage of removed items is prohibited.

10. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

B. Salvaged Items:

1. Sort and organize salvaged materials as they are removed from the structure.

2. Pack, crate or band materials to keep them contained and organized.

3. Store items in a secure and weather protected area until removed from the site or transferred to Owner.

4. Transport items to Owner's storage area designated by the Owner.

5. Protect items from damage during transport and storage.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition activities. When permitted by the Architect, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.

D. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.

E. Remove air-conditioning equipment without releasing refrigerants.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled or otherwise indicated to remain Owner's property, remove demolished materials from the Project site and legally dispose of them.

1. Do not allow demolished materials to accumulate on site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist or other device that will convey debris to grade level in a controlled descent.

4. Comply with requirements specified in Section 01 74 19.

3.07 CLEANING

A. Sweep the building broom clean on completion of selective demolition operation.

B. Change filters on air-handling equipment on completion of selective demolition operations.

3.08 CONSTRUCTION WASTE MANAGEMENT

A. As specified in Section 01 74 19.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing metal fabrications made from steel shapes, plates, bars, strips, tubes, pipes and castings not a part of structural steel or specified in other Sections, including but not limited to the following items:

1. Miscellaneous steel framing for partition supports.

2. Handrail brackets.

3. Countertop support brackets.

4. Guardrails, railings and handrails.

5. Metal framing for fences and gates.

6. Elevator guide rail support brackets.

7. Steel pipe bollards.

8. Stair nosings.

9. Metal gratings.

10. Exterior vertically-oriented banner hanging system.

11. Interior ceiling channel framing system.

12. Miscellaneous angles, plates, bars, rods and other items not specified in other Sections but shown or required to complete the work.

B. Related Sections:

1. Metal stairs are specified in Section 05 51 00.

2. Meta ladders are specified in Section 05 51 33.

3. Decorative metal stairs are specified in Section 05 71 00.

4. Decorative metal railings are specified in Section 05 73 00.

5. Exterior architectural woodwork is specified in Section 06 40 13.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. Handrails and Railings: Design, engineer, fabricate and install railings and handrails to withstand the following structural loads in accordance with California Building Code (CBC) Section 1607.7:

1. Handrail and guardrail assemblies shall be designed to resist a load of 50-plf applied in any direction at the top.

2. Handrail and guardrail assemblies shall be able to resist a concentrated load of 200-pounds applied in any direction at any point along the top.

3. Intermediate rails, balusters and panel fillers shall be designed to withstand a horizontally applied load of 50-psf applied horizontally at right angles.

4. Handrails and Railings shall comply with ADA requirements.

1.03 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Include information on cast nosings, treads, steel floor plate, paint products, and grout.

C. Shop Drawings: Include plans, elevations and details of metal fabrications and their connections. Show anchorage and accessory items. Furnish templates for anchors and bolts installed under other Sections.

1.04 QUALITY ASSURANCE

A. Stairway handrails shall comply with California Building Code (CBC) Section 1133B.4.1.

B. Ramp handrails shall comply with CBC Section 1133B.5.5.

C. Ramp guardrails shall comply with CBC Section 1133B.5.7.

D. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the work.

E. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS D1.1, D1.2, and D1.3 as applicable. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule to avoid delay of work.

1.06 SEQUENCING AND SCHEDULING

A. Mount handrails only on gypsum board assemblies reinforced to receive anchors, and where the location of concealed anchor plates has been marked for the installer.

B. Painting: Items specified in this Section as having a shop applied prime coat will be job painted as specified in Section 09 91 00, unless otherwise noted.

PART 2 - PRODUCTS

2.01 FERROUS METALS

A. General: For fabrication of metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.

B. Steel Plates, Shapes and Bars: ASTM A36.

C. Steel Tubing: Cold-formed, ASTM A500; or hot-rolled, ASTM A501.

D. Structural Steel Sheet: Hot-rolled, ASTM A570; or cold-rolled ASTM A611, Class 1.

E. Galvanized Structural Steel Sheet: ASTM A653, galvanized in accordance with ASTM A525, G90 coating designation.

F. Steel Pipe: ASTM A53; type and grade selected by fabricator; black finish unless galvanizing is indicated or specified; standard weight, schedule 40, unless otherwise indicated.

G. Gray Iron Castings: ASTM A48, Class 30.

H. Malleable Iron Castings: ASTM A47, grade selected by fabricator.

2.02 ALUMINUM

A. Extrusions: ASTM B221, alloy 6063-T6.

B. Sheet: ASTM B209, alloy 5005-H15.

C. Bars, Rods and Wires: ASTM B211.

D. Drawn Seamless Tubing: ASTM B210.

E. Castings: ASTM B26 or B108, alloy 214 unless otherwise recommended by aluminum producer or finisher.

2.03 FASTENERS

A. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A, with hex nuts, ASTM A563, and flat washers.

B. Machine Screws: ANSI B18.6.3.

C. Lag Bolts: ANSI B18.2.1.

D. Wood Screws: Flat head, carbon steel, ANSI B18.6.1.

E. Plain Washers: Round, carbon steel, ANSI B18.22.1.

F. Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.

G. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, determined in accordance with ASTM E448.

2.04 GROUT

A. Non-Shrink Non-Metallic Grout: Euclid Chemical Co. "Euco N-S Grout", L&M Construction Chemicals, Inc. "Crystex", Master Builders Technologies, Inc. "Masterflow 928 and 713" or approved equal.

2.05 PAINT

A. Metal Primer: SSPC 20, Type 2.

1. Exterior Exposure: Tnemec 90-97 Tnemec Zinc or approved equal.

2. Interior Exposure: VOC compliant rust-inhibitive alkyd primer.

3. Exposed to view items to be field painted shall be primed with a primer compatible with final finish coats specified in Section 09 91 00.

B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel; Rust-Oleum Corp. "Zinc-Rich Cold Galvanizing Compound", Tnemec 90-93, ZRC Worldwide "Galvalite" or approved equal.

2.06 MANUFACTURED ITEMS

A. Handrail Brackets: Trimco Model 253 or approved equal. Provide with back plate to prevent crushing finish wall material.

B. Abrasive Stair Nosings:

1. Steel Pan Stairs: American Safety Tread Co., Inc. Type 9511, Wooster Products, Inc. "Spectra" Type WP3J or approved equal, color as selected by the Architect. Provide contrasting color at top and bottom treads.

2. Cast-in-Place Concrete Stairs: American Safety Tread Co., Inc. Type 3511, Wooster Products, Inc. "Spectra" Type WP3C or approved equal, color as selected by the Architect. Provide contrasting color at top and bottom treads.

C. Interior Ceiling Channel Framing System: Unistrut P1001 Grid or approved equal. Finish as selected by the Architect.

2.07 FABRICATION, GENERAL

A. Workmanship:

1. Use materials of size and thickness indicated or required to produce strength and durability in finished product for use intended.

2. Work to dimensions indicated,

3. Form exposed work true to line and level with accurate angles and surfaces and straight, sharp edges.

4. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise indicated.

5. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces. Welds shall be imperceptible in the finished work.

7. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use Phillips flat- head countersunk screws or bolts for exposed fasteners, unless tamperproof security screws are indicated.

8. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

B. Galvanizing: Provide zinc coating for items indicated or specified to be galvanized, as follows:

1. ASTM A153 for galvanizing iron and steel hardware.

2. ASTM A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299-inch thick and heavier.

C. Fabricate joints exposed to the weather to exclude water or provide weep holes.

D. Shop Painting:

1. Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces.

2. Remove scale, rust and other deleterious materials before applying shop coat. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2, SP-3, or SP-7.

3. Remove oil, grease and similar contaminants in accordance with SP-1.

4. Brush or spray on primer in accordance with manufacturer's instructions, at a rate of 2.0-mils thickness for each coat.

5. Apply one shop coat to fabricated metal items, except apply 2-coats to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish from the first.

7. Primer on exposed to view items to be field painted shall be smooth and suitable for application of final finish coats specified in Section 09 91 00.

8. Apply a heavy coat of bituminous paint, compounded for application in 30-mil coat, to metal surfaces in contact with concrete, masonry and dissimilar metals. Do not apply on exposed surfaces.

2.08 MISCELLANEOUS METAL FABRICATIONS

A. Loose Bearing and Leveling Plates: Provide for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill to receive anchor bolts and for grouting as required. Galvanize after fabrication.

B. Curb Nosings:

1. Fabricate of structural steel shapes of welded construction with mitered corners and continuously welded joints.

2. Provide anchors welded to nosings for embedding in concrete or masonry construction, spaced not more than 6-inches from each curb end, 6-inches from corners and 24-inches on center unless otherwise indicated.

3. Finish: Galvanized.

C. Miscellaneous Framing and Supports:

1. Provide miscellaneous framing and supports not a part of structural steel framework, as required to complete work.

2. Fabricate to sizes, shapes and profiles shown or required.

3. Fabricate from structural steel shapes and plates and steel bars of welded construction using mitered joints for field connection.

4. Cut, drill and tap units to receive hardware and similar items.

5. Furnish integrally welded anchors for casting into concrete or building into masonry.

6. Finish: Galvanize exterior frames and supports, shop prime interior frames and supports.

D. Steel Tube Railings and Handrails: Fabricate to design, dimensions and details indicated. Maximum member size shall be 1-1/2-inch O.D. Railings and handrails shall comply with ADA requirements.

1. Interconnect railing and handrail members by butt welding or welding with internal connectors.

2. Provide coped joints at tee and cross sections.

3. Form simple and compound curves by bending tubing in jigs to produce uniform curvature for each repetitive configuration. Maintain cylindrical cross-section of tube throughout entire bend without buckling, twisting or deforming exposed surfaces.

4. Provide wall returns at ends of wall-mounted handrails.

5. Close exposed ends of tubing by welding 3/16-inch steel plate in place or by using prefabricated fittings.

6. Flanges, Fittings and Anchors: Provide end closures, flanges, miscellaneous fittings and anchors for interconnections of tubing and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry.

7. Pipe Sleeves:

a. Provide galvanized pipe sleeves not less than 6-inches long with an inside diameter not less than 1/2-inch greater than the outside diameter of pipe or tube.

b. Provide steel plate closure welded to bottom of sleeve, width and length not less than 1-inch greater than outside diameter of sleeve.

c. Provide friction fit, removable covers designed to keep sleeves clean and hold top edge of sleeve 1/2-inch below finished surface of concrete.

8. Finish: Galvanize exterior steel railings, including tubing, fittings, brackets, fasteners, and other ferrous components. Provide black steel tubing for interior railings.

E. Stair Railings and Handrails: Comply with specified requirements for steel tube railings and handrails. Connect railing posts to stair framing by welding. Maximum member size shall be 1-1/2-inch O.D. Railings and handrails shall comply with ADA requirements.

F. Bollards: Fabricate bollards from galvanized steel pipe of diameter and height indicated. Embed in concrete footings, fill with concrete and close top end by welding a 1/4-inch steel plate in place or provide a smooth concrete domed cap.

G. Gates:

1. Fabricate from steel tubing of sizes and configurations indicated. Tubing gauges shall be as recommended by fabricator.

2. Each intermediate vertical member shall be solidly welded to top and bottom rails. Exposed welds shall be ground smooth, flush and imperceptible.

3. Provide hardware required for smooth and easy operation. Reinforce, drill, punch and tap members as required to receive hardware.

4. Finish: Galvanize exterior gates, including tubing, fittings, brackets, fasteners and other ferrous components.

H. Bar Gratings:

1. Provide steel bar gratings using bars of type, material, sizes, spacing, and construction indicated.

2. Comply with applicable requirements of National Association of Architectural Metal Manufacturers (NAAMM) "Metal Bar Grating Manual".

3. Type: Welded.

4. Traffic Surface: Striated.

5. Steel Finish: Hot-dip galvanized after fabrication.

6. Provide removable grating sections with end-bearing bars for each panel, 4-saddle clip anchors designed to fit over 2-bearing bars, and 4-stud bolts with washers and nuts.

7. Notch gratings for penetrations. Layout units to allow removal without disturbing items penetrating grating.

8. Provide banding for openings in grating separated by more than 4-bearing bars, of same material and size as bearing bars.

9. Weld stud bolts to receive saddle clip anchors to supporting steel members.

I. Exterior Vertically-Oriented Banner Hanging System:

1. Fabricate from hot-dip galvanized steel shapes as indicated.

2. Provide wall-mounted brackets, top and bottom poles and pulley system.

3. Finish: To be selected by the Architect.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors.

3.02 INSTALLATION

A. General:

1. Fastening to In-Place Construction: Provide threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

2. Cutting, Fitting and Placement:

   a. Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications.

   b. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.

   c. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry or similar construction.

3. Fit exposed connections together forming tight hairline joints.

   a. Weld connections not shop welded.

   b. Grind exposed joints smooth and imperceptible, and touch-up shop paint coat.

   c. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and intended for bolted or screwed field connections.

4. Field Welding: Comply with AWS for procedures of manual shielded metal-arc welding, appearance and quality of welds, and methods used in correcting welding work.

5. Install prefabricated items in accordance with manufacturers' instructions.

B. Setting Loose Plates:

1. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve surface bond. Clean bottom surface of bearing plates.

2. Set loose leveling and bearing plates on wedges, or other adjustable devices.

3. Tighten anchor bolts after the bearing members have been positioned and plumbed.

4. Cut-off protruding ends of wedges flush with the edge of the bearing plate before packing with grout.

5. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations.

6. Pack grout solidly between bearing surfaces and plates to ensure no voids remain.

C. Gratings:

1. Weld non-removable units to supporting members or framework.

2. Secure removable units to supporting members or framework with galvanized machine screws, or manufacturer's standard saddle or clip units.

D. Steel Tube Railings and Handrails:

1. Adjust railings prior to anchoring to ensure matching alignment at abutting joints.

2. Space posts as indicated.

3. Plumb posts in each direction.

4. Anchor posts in concrete with pipe sleeves preset and anchored into concrete. After posts are inserted in sleeves, fill annular space between post and sleeve solid with non-shrink, non-metallic grout, mixed and placed to comply with grout manufacturer's directions.

5. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.

6. Anchor rail ends into concrete and masonry with round steel flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.

7. Anchor rail ends to steel with steel oval or round flanges welded to rail ends and bolted to structural steel members.

8. Secure handrails to wall with wall brackets and end fittings.

   a. Locate brackets as indicated.

   b. Secure wall brackets in accordance with manufacturer's instructions.

9. Expansion Joints: Provide at intervals not exceeding 40-feet. Provide slip joint with internal sleeve extending 2-inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6-inches of posts.

E. Gates: Fit hardware accurately and hang gates to operate freely without sticking or binding.

F. Stair Nosings: Install with anchorage complying with manufacturer's recommendations.

G. Bollards: Anchor bollards in concrete with preset pipe sleeves. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solid with nonshrink, nonmetallic grout.

3.03 ADJUST AND CLEAN

A. Touch-Up Painting: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0-mils.

B. Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and spot prime with specified primer applied to a minimum dry film thickness of 2.5-mils.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for miscellaneous rough carpentry items, including but not limited to the following;

1. Wood blocking and backing.

2. Plywood backing at mechanical, electrical and telecommunications rooms.

3. Plywood at acoustic suspended ceilings in the STEM Lab.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Wood treatment is specified in Section 06 05 73.

3. Metal suspension systems are specified in Section 09 22 26.23.

4. Acoustic insulation is specified in Section 09 81 00.

1.02 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Section 01 61 00.

B. Keep materials under cover and dry. Protect against exposure to weather and contact with wet or damp surfaces.

C. Stack lumber, plywood and other panels; provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.01 LUMBER

A. Manufacture lumber to comply with PS 20 and with applicable grading rules of inspection agencies certified by ALSC Board of Review.

B. Factory-mark each piece of lumber identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Nominal sizes are indicated, except as indicated by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use. Provide dressed lumber, S4S, unless otherwise indicated.

D. Moisture Content: 19 percent maximum.

E. Species and Grade: Douglas Fir, No. 2 unless otherwise indicated.

2.02 PLYWOOD

A. Standards: Comply with requirements of PS 1 Voluntary Product Standard "Construction and Industrial Plywood" for veneer plywood and APA PRP-108 "Performance Standards and Policies for Structural-Use Panels" for performance-rated panels.

B. Miscellaneous Exposed Plywood: APA A-D Interior, thickness indicated.

C. Plywood Ceiling Panels at STEM Lab: APA A-D Interior, 3/4-inch thick, tongue-and-groove long edges, fire-retardant treated as specified in Section 06 05 73.

2.03 FASTENERS

A. General: Provide fasteners with hot-dip zinc coating in accordance with ASTM A153 or stainless steel.

B. Nails, Wire, Brads, Staples: FS FF-N-105.

C. Bolts: ASTM A307, Grade A; with hex nuts and flat washers.

D. Screws: Type, size and length appropriate for securing gypsum and plywood sheathing to metal studs.

2.04 MISCELLANEOUS MATERIALS

A. Joint Sealant at Plywood Ceiling Panels at STEM Lab: Acoustical Surfaces “Acoustiseal AS-29” or approved equal.

B. Acoustic Insulation: As specified in Section 09 81 00.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Discard units of material with defects which might impair quality of work, and units in sizes that would require an excessive number or poor arrangement of joints.

B. Cut and fit miscellaneous carpentry accurately. Install members plumb and true to line and level.

C. Securely attach carpentry work to substrate by anchoring and fastening as indicated and required.

D. Use fasteners of appropriate type and length and compliant with CBC Chapter 23. Install fasteners without splitting wood; pre-drill as required.

3.02 WOOD GROUNDS, NAILERS, AND BLOCKING

A. Provide where indicated and required for attachment of other work. Form to shapes indicated and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces.

3.03 PLYWOOD PANELS

A. Saw cut plywood accurately for tight fit.

B. Install with grain of outer plies at right angles to supports.

C. Fasten securely at each support with self-tapping sheet metal screws driven flush with face of plywood, and terminate ends only over supports.

D. Maintain tight joints but do not force panels into place.

E. Comply with additional recommendations in APA Form E30, "Design/Construction Guide - Residential & Commercial".

F. Install plywood ceiling panels at STEM Lab with joints sealed with specified joint sealant. Provide acoustic insulation above plywood panels as indicated.

3.04 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Separate the following categories for salvage or re-use on the site:

1. Sheet materials larger than 2-sq. ft.

2. Solid wood trim longer than 16-inches and multiple offcuts of any size larger than 12-inches.

C. The following categories may be re-used in the manufacture of particleboard or medium density fiberboard:

1. Composite wood.

2. Clean dimensional lumber.

D. Separate the following categories for disposal and place in designated areas for hazardous materials:

1. Treated, stained, painted, or contaminated wood.

END OF SECTION

SECTION 06 16 43

GYPSUM SHEATHING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes exterior gypsum wall and roof sheathing, fasteners, and accessories.

B. Related Sections:

1. Sheathing paper is specified in Section 06 13 73.

2. Gypsum board is specified in Section 09 29 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's descriptive literature indicating material composition, thickness, size and fire resistance. Include manufacturer's certification that gypsum sheathing complies with specified fire-resistance requirements.

C. Shop Drawings: Show fastener patterns and installation details.

1.03 QUALITY ASSURANCE

A. Fire Resistance Ratings: Gypsum sheathing shall have a flame spread of 0 and smoke developed of 0 when tested in accordance with ASTM E84 and be non-combustible when tested in accordance with ASTM E136.

B. Gypsum sheathing shall comply with ICC-ES ER-4305.

C. Gypsum sheathing shall be manufactured to conform to the physical requirements of ASTM C79 for gypsum sheathing board and shall have the following performance characteristics.

	1/2" thick Sheathing	**5/8" thick Sheathing**
Thickness	1/2" +/- 1/32"	5/8" +/- 1/32"
Weight, lbs/sg. ft.	1.900	2.500
Width, nominal	4 feet +/- 1/8"	4 feet +/- 1/8"
Length, standard	8 feet and 10 feet, +/- 1/4"	8 feet and 10 feet, +/- 1/4"
Edges	Square	Square
Core	Water resistant	Water resistant
Permeance, ASTM E96	23.1 perms	12.4 perms

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Section 01 61 00.

B. Each bundle or package of sheathing shall bear the manufacturer's name and/or trademark, the NES logo and evaluation report number (ER-4305) for field identification.

C. Keep materials under cover and dry. Protect against exposure to weather and contact with wet or damp surfaces.

D. Stack gypsum sheathing and provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.01 GYPSUM SHEATHING

A. Gypsum Wall Sheathing: Georgia Pacific "Dens-Glass Exterior Guard Gold", USG "Securock" or approved equal panel with glass mat faced water-resistant treated core, 1/2-inch thick unless otherwise indicated, complying with ASTM C1177.

1. Gypsum wall sheathing shall be resistant to mold and mildew when tested in accordance with ASTM D3273.

2. Where indicated for fire-rated walls, provide Georgia Pacific "Dens-Glass Gold Fireguard", USG "Securock" or approved equal glass mat faced water-resistant treated core panel, 5/8-inch thick, with Type X rating as defined in ASTM C1396. Provide two layers at 2-hour exterior fire-rated walls in accordance with UL Design No. U411.

B. Gypsum Roof Sheathing: Georgia Pacific "Dens-Deck Roof Board", USG "Securock Glass-Mat Roof Board" or approved equal glass mat faced silicone-treated gypsum core panel, 1/2-inch thick.

C. Fire Resistance:

1. Noncombustible when tested in accordance with ASTM E136.

2. Flame spread 10, smoke developed 0, when tested in accordance with ASTM E84.

D. When tested in accordance with ASTM E119, 1/2-inch thick sheathing demonstrated that it met the code requirements for use as a 15-minute thermal barrier for protecting foam plastics which might be installed as a part of an exterior wall covering assembly.

E. When Tested in accordance with ASTM E119, 5/8-inch sheathing applied to a partition in a single-layer nail application on each face of load-bearing wood framing members provided a one-hour fire resistance, qualifying it for the "Type X" designation of ASTM C79.

2.02 MISCELLANEOUS MATERIALS

A. Fasteners: Provide bugle or wafer head, self-tapping, corrosion-resistant, fine thread fasteners as recommended by gypsum sheathing manufacturer. Fasteners shall have a minimum 2,000-hour resistance to salt spray when tested in accordance with ASTM B117.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Cut and fit gypsum sheathing accurately. Install members plumb and true to line and level.

B. Securely attach to substrate by anchoring and fastening as indicated and required.

C. Use fasteners of appropriate type and length.

3.02 GYPSUM WALL SHEATHING

A. Provide gypsum board sheathing where indicated.

B. Fasten to exterior face of stud framing for exterior walls in accordance with manufacturer's instructions, applicable instructions in GA-253 and ASTM C1280, and ICC-ES ER-4305.

C. Use maximum lengths possible to minimize number of joints.

D. Fasten with screws of appropriate type and length.

E. Attach sheathing to metal framing with screws spaced 8-inches o.c. at perimeter where there are framing supports and 8-inches o.c. along intermediate framing in field.

F. Drive fasteners to bear tight against and flush with surface of sheathing. Do not counter sink.

G. Locate fasteners minimum 3/8-inch from edges and ends of sheathing panels, tight against and flush with surface of sheathing.

H. For transverse wind load resistance, comply with the requirements specified in ICC-ES ER-4305.

I. Provide two layers of specified Type X rated sheathing applied in accordance with UL Design No. U411. Apply base layer vertically and attach with 1-inch Type S corrosion-resistant bugle head screws spaced 16-inches on center. Apply face layer vertically with 1-5/8-inch Type S corrosion-resistant bugle heads screws spaces 8-inches on center with joints staggered from base layer.

3.02 GYPSUM ROOF SHEATHING

A. General: Install in accordance with manufacturer's instructions using fasteners in accordance with FM requirements for I-60 wind uplift.

B. Locate edge joints on and parallel to metal deck ribs. Stagger end joints of adjacent boards.

END OF SECTION

SECTION 06 40 23

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing interior architectural woodwork items including the following:

1. Interior standing and running trim.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Exterior architectural woodwork is specified in Section 06 40 13.

3. Architectural wood casework is specified in Section 06 41 00.

4. Flush wood doors are specified in Section 08 14 16.

5. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Shop Drawings: Show details of fabrication and installation, dimensioned plans, elevations, and sections.

1. Shop drawings shall comply with Architectural Woodwork Standards (AWS) Section 1 – Submittals.

2. Apply a Woodwork Institute Certified Compliance Label to the first page of the shop drawings.

C. Samples:

1. Lumber with or for transparent finish, 50-square inches, for each species and cut, finished on one side and one edge.

2. Corner pieces of miter joints for standing trim.

D. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.

E. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other specified information.

1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the work.

B. Installer Qualifications: Arrange for interior architectural woodwork installation by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this Project.

C. WI Certified Compliance Program (CCP):

1. Before delivery to the Project site, provide a Woodwork Institute Certified Compliance Certificate indicating the products being furnished and certifying that they meet the requirements of the Architectural Woodwork Standards and of the plans and specifications

2. Upon completion of installation, furnish a WI Certified Compliance Certificate for the installation.

3. In the event of question as to compliance with the referenced standard of any item of work, the Architect may require independent inspection service of questioned items as specified in "Independent Inspection Service" of "WI Services and Quality Control Options" published by the WI.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

C. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet specified requirements.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.

1.06 COORDINATION

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

B. Fabricated woodwork shall be left in a well ventilated warehouse for a minimum of 72-hours prior to delivery to the Project site.

1.07 INDOOR AIR QUALITY

A. Do not use wood products containing urea formaldehyde glues inside the shell of the building.

B. When machining plastic products, protect surrounding areas from dust.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Provide materials that comply with requirements of the Architectural Woodwork Standards (AWS) for each type of woodwork and AWS quality grade specified.

B. Lumber Standards: Comply with PS 20 for lumber and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

C. Plywood Standards: Comply with PS 1 or APA PRP-108.

1. Plywood products shall contain no added urea-formaldehyde as a binder.

D. Particleboard: One of the following at Contractor's option:

1. Particleboard complying with ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.

2. Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.

E. Medium Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

F. Furring, Blocking, Shims and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15-percent moisture content.

G. Screws: Material, type, size, and finish required for each use.

H. Nails: Material, type, size, and finish required for each use.

I. Anchors: Material, type, size, and finish required for each substrate for secure anchorage.

J. Glue: As recommended by manufacturer for general carpentry use.

K. Adhesives: As recommended by manufacturer. Do not use adhesive that contain urea formaldehyde.

2.02 FABRICATION, GENERAL

A. Comply with Architectural Woodwork Standards (AWS) requirements for the grade specified.

B. Wood Moisture Content: Comply with requirements of referenced quality standards for moisture content of lumber in relation to relative humidity conditions existing at time of fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to a radius as follows:

1. Corners and edges of solid wood members less than 1-inch in nominal thickness: 1/16-inch.

2. Edges of rails and similar members more than 1-inch in nominal thickness: 1/8-inch.

D. Complete fabrication, including assembly and finishing before shipment to Project site to maximum extent possible. Disassemble components only as required for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Shop-cut openings to maximum extent possible. Locate openings accurately and use templates for roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges and cutouts.

2.03 MILLWORK AND TRIM FOR TRANSPARENT FINISH

A. Grade: Premium.

B. Backout or groove backs of flat trim members and kerf backs of other wide flat members. Back miter any exposed ends to conceal relieved or grooved backs.

C. Assemble casings in plant except where limitations of access to place of installation require field assembly.

D. Lumber Species: White Birch, quarter sliced.

E. Finish: Prefinished as specified.

2.04 SHOP-FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

A. Quality Standard: Comply with Architectural Woodwork Standards.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparation of architectural woodwork.

C. Transparent Finish for Open-Grain Woods:

1. Grade: Premium.

2. AWS Finish System 12: Polyurethane, Water-Based.

3. Staining: Match approved sample for color.

4. Effect: Closed grain (filled finish).

5. Sheen: Satin 31- to 45-deg.

D. Transparent Finish for Closed-Grain Woods:

1. Grade: Premium.

2. AWS Finish System 12: Polyurethane, Water-Based.

3. Staining: Match approved sample for color.

4. Effect: Closed grain.

5. Sheen: Satin 31- to 45-deg.

PART 3 - EXECUTION

3.01 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.02 INSTALLATION

A. General: Install interior architectural woodwork in accordance with Architectural Woodwork Standards (AWS) for same grade specified for woodwork involved.

B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8-inch in 8'-0" for plumb and level.

C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. Millwork and Trim: Install with minimum number of joints possible, using full-length pieces to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns and miter at corners.

3.03 ADJUSTMENT AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.04 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer, to ensure woodwork is without damage or deterioration at time of final acceptance.

3.05 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Separate the following categories for salvage or re-use on the site:

1. Sheet materials larger than 2-sq. ft.

2. Solid wood trim longer than 16-inches and multiple offcuts of any size larger than 12-inches.

C. Separate the following for recycling. Material shall be placed in source-separated or comingled recycling bins.

1. Composite wood.

2. Clean dimensional lumber.

D. Separate the following categories for disposal and place in designated areas for hazardous materials:

1. Treated, stained, painted, or contaminated wood.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing thermal insulation.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Roof board insulation directly under roof membrane is specified in Section 07 22 16.

3. Firestopping insulation is specified in Section 07 84 00.

4. Acoustic insulation is specified in Section 09 81 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's specifications for each type of insulation required.

1.03 QUALITY ASSURANCE

A. Thermal Conductivity: Where insulation is indicated or specified by "R" value, provide thickness required to achieve indicated value. Use aged and settled values for thermal resistance factors (R-values), tested in accordance with ASTM C518 at 75-deg. F. and 50-percent relative humidity for at least 6-months.

B. Fire Ratings: Comply with fire-resistance and flammability ratings specified.

C. Insulation shall be certified by the manufacturer to comply with California standards for insulating materials.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Protect insulation from physical damage and from becoming wet or soiled. Comply with manufacturer's recommendations for handling, storage and protection during installation.

1.05 TESTING AND INSPECTIONS

A. Inspect insulation for proper installation. Correct defects such as voids, gaps or insulation compressed behind pipes before accepting work.

1.06 INDOOR AIR QUALITY

A. Protect ducts and HVAC system from loose insulation particulates.

B. Provide temporary ventilation of building areas where building insulation is being installed.

PART 2 - PRODUCTS

2.01 BATT AND BLANKET INSULATION

A. Foil-Faced Formaldehyde-Free Mineral/Glass Fiber Blanket/Batt Insulation:

1. Approved Manufacturers: Johns Manville "Thermal-SHIELD Free FSK-25", Owens Corning "EcoTouch Flame Spread 25 Insulation" or approved equal.

2. Material: Thermal insulation produced by combining mineral-glass fibers with formaldehyde-free thermosetting resins to comply with ASTM C665, Type III, Class A, foil-scrim-kraft vapor retarder membrane on one face.

3. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50 when tested in accordance with ASTM E84.

4. Thickness: As required for R-19 in walls and R-30 on underside of slabs where roof insulation is not used. Size batts to fill framing cavity.

B. Unfaced Formaldehyde-Free Thermal Batt/Blanket Insulation:

1. Approved Manufacturers: Johns Manville "Fromaldehyde-free Unfaced", Owens Corning "EcoTouch Unfaced Insulation" or approved equal.

2. Material: Thermal fiberglass insulation made from resilient glass fibers bonded with a formaldehyde-free acrylic thermosetting binder, complying with ASTM C665, Type I.

3. Surface Burning Characteristics: Flame spread 25 or less; smoke developed 50 or less, when tested in accordance with ASTM E84.

4. Thickness: As required for R-19 in walls and R-30 on underside of slabs where roof insulation is not used. Size batts to fill framing cavity.

C. Recycled Cotton Insulation:

1. Approved Manufacturers: Bonded Logic, Inc. "UltraTouch Natural Cotton Fiber Insulation" or approved equal.

2. Material: Unfaced natural cotton fiber insulation made from post-industrial natural cotton fibers that have been thermally bonded. Insulation shall be environmentally safe, sustainable, non-allergenic, non-hazardous, non-formaldehyde, non-itch product.

3. Thickness: As required for R-19 in walls and R-30 in ceilings. Size batts to fill framing cavity.

4. Surface Burning Characteristics: Flame spread 5; smoke developed 35, when tested in accordance with ASTM E84.

5. Mold/Mildew/Fungi Resistance, ASTM C739: Pass-No Growth.

6. Corrosion Resistance, ASTM C739: Pass.

7. Odor Emission, ASTM C739: Pass.

8. Moisture Absorption, ASTM C39: Pass, less than 15-percent.

9. Insulation shall contain over 80-percent post-industrial recycled content.

D. Mineral Fiber Curtain Wall Insulation:

1. Approved Manufacturers: Thermafiber "Thermafiber Curtain Wall CW-90 Insulation, Fibrex Insulations Inc. "Fibrex Curtain Wall (CW) Insulation" or approved equal.

2. Material: Mineral-wool-type insulation, non-combustible when tested in accordance with ASTM E136, moisture-resistant, non-corrosive, non-deteriorating, mildew-proof and vermin-proof, complying with ASTM C665, Type I and II, Class A, Category 1.

3. Surface Burning Characteristics: Flam spread 0, smoke developed 0, when tested in accordance with ASTM E84.

4. Density: 8.0-pcf unless otherwise recommended by manufacturer for installation conditions.

5. Thickness: As indicated.

6. Provide dark colored insulating for backing glass spandrel panels.

E. Poly-Encapsulated Formaldehyde-Free Thermal Batt/Blanket Insulation:

1. Approved Manufacturers: Johns Manville “ComfortTherm” or approved equal.

2. Material: Poly-encapsulated formaldehyde-free fiberglass insulation wrapped in plastic, complying with ASTM C665, Type II, Class A.

3. Surface Burning Characteristics: Flame spread 25 or less; smoke developed 50 or less, when tested in accordance with ASTM E84.

4. Thickness: As required for indicated R-values. Size batts to fill framing cavity where required.

5. Provide in ceiling plenum areas.

2.02 MISCELLANEOUS MATERIALS

A. Mechanical Anchors: Miracle Adhesive Corp. "Stuck-Up", Stic-Klip Mfg. Co. "Stic-Klip" or approved equal. Provide protective covers or an approved unpointed clip for areas under 7'-0" above the floor.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Comply with manufacturer's instructions for installation conditions.

2. Do not install insulation until building is sufficiently enclosed or protected against absorption of moisture by the insulation, and do not install insulation unless supporting framing and construction is in a thoroughly dry condition.

3. Install snugly between framing members with ends snugly fitted between units and against adjacent construction.

4. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.

5. Where door, window and skylight frames occur in framing, cut additional strips of insulation and hand-pack as required to fill voids in and around such frames.

6. Use insulation free of ripped backs and edges.

B. Thermal Insulation:

1. Install with vapor barrier facing to building interior.

2. Install to completely fill typical and odd spaces in framing where required.

3. Tape joints and ruptures in vapor retarder to ensure airtight installation.

C. Horizontal Insulation:

1. Install insulation over insulation fasteners. Where required, install insulation fasteners prior to application of sprayed-on fireproofing.

2. Space fasteners and secure in a full bed of adhesive as recommended by manufacturer.

3. Lay out insulation for minimum of joints, and with no single pieces less than 24-inches wide nor less

than 48-inches long, unless otherwise approved.

4. Offset intermediate end joints in adjacent panels not less than 48-inches.

5. Do not install insulation until clip adhesive is set.

6. Install insulation fully bearing against substrates, with tightly fitted joints.

7. Install fastener caps firmly against insulation face without compressing the material. Bend clip prongs flat against caps.

D. Curtain Wall Insulation:

1. Mechanically attach curtain wall insulation to vertical aluminum mullions with fasteners recommended by insulation manufacturer. Adhesive attachment is not acceptable.

2. Provide supplementary framing members if required to prevent bowing of the curtain wall insulation due to pressure applied from compression-fit safing insulation. Coordinate with the work of Section 07 84 00.

3.02 PROTECTION

A. Protect installed insulation and vapor barriers from harmful exposures and from physical damage.

3.03 WASTE MANAGEMENT

A. Comply with Section 01 74 19.

B. Plan and coordinate the insulation work to minimize the generation of offcuts and waste. Remove insulation scraps to the maximum extent feasible.

C. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing firestopping.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Cementitious fireproofing is specified in Section 07 81 16.

3. Joint sealants are specified in Section 07 92 00.

4. Non-structural metal framing is specified in Section 09 22 16.

5. Gypsum board is specified in Section 09 29 00.

6. Acoustic insulation is specified in Section 09 81 00.

7. Plumbing is specified in Division 22.

8. Electrical is specified in Division 26.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide firestopping systems capable of closing or filling through-penetrations created by the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or by the deflection of sheet metal due to thermal expansion.

B. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

C. For firestopping exposed to view, provide products when flame-spread values of less than 25 and smoke-developed values of less than 450, when tested in accordance with ASTM E84.

1.03 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's descriptive, technical data and illustrations. Include manufacturer's installation instructions.

C. Certification:

1. Manufacturer's certification that products comply with local regulations controlling use of volatile organic compounds (VOC's) and are nontoxic to building occupants.

2. Manufacturer's certification that firestopping materials comply with ASTM E814 and UL 147.

D. UL Design Numbers: Furnish UL Design No. from the "Fire Resistance Directory - Volume II" for each required penetration type and configuration. Indicate which materials will be used in firestopping the penetration. Reference architectural, mechanical, plumbing and electrical drawings.

E. Furnish documentation indicating deflection and elongation capacity of all head of wall assemblies are equivalent in capacity to design assemblies.

1.04 QUALITY ASSURANCE

A. Firestopping materials and systems shall be listed and labeled in accordance with requirements of Underwriters Laboratories, Inc. (UL) Building Materials Directory.

B. Firestopping materials shall conform to California Building Code (CBC) for fire resistance standards and requirements for penetrations in walls, partitions, and floor/ceiling and floor/roof assemblies.

C. Firestopping materials shall comply with ASTM E814 and UL 1479.

D. Firestopping sealants shall comply with ASTM C719 and ASTM C920.

E. Form materials to remain in place in the completed work and sealant used for firestopping work shall be UL listed and labeled.

F. Firestopping materials shall be rated as required when tested in accordance with ASTM E119.

G. Firestopping materials shall be asbestos free and shall not incorporate nor require the use of hazardous solvents.

H. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surface.

I. Installer shall have a minimum of 5-years experience installing UL listed firestop systems in similar type construction.

1.05 JOB CONDITIONS

A. Follow manufacturer's instructions for temperature, ventilation, and other conditions for mixing and installing foam seals.

B. Observe and follow manufacturer's precautions when using materials considered toxic and hazardous.

C. Maintain current copy of UL "Fire Resistance Directory" on Project site.

D. Installation of firestopping shall precede finishing of gypsum board.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver materials in the manufacturer's unopened containers and packages with manufacturer's name, labels, product identification, lot numbers, and mixing and installation instructions, as applicable.

C. Store materials in unopened containers and packages, and under conditions recommended by manufacturer.

D. Store and handle firestopping materials in accordance with manufacturer's Material Safety Data Sheets.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilation: Ventilate firestopping in accordance with manufacturers' instructions by natural means or forced air circulation.

1.08 SEQUENCING AND SCHEDULING

A. Perform work of this and other Sections in proper sequence to prevent damage to the firestopping materials and to ensure that their installation will occur prior to enclosing or concealing work.

B. Do not cover firestopping materials until they have been properly inspected and accepted by the authority having jurisdiction.

PART 2 - PRODUCTS

2.01 FIRESTOPPING, GENERAL

A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the penetrating items.

B. Accessories: Provide components of each firestopping system required to install fill materials. Use only components specified by firestopping manufacturer and which are approved by UL for the designated fire-resistance-rated system.

C. Manufacturers or systems not listed in UL "Fire Resistance Directory" but who can furnish certification of UL approval may be used in the work.

2.02 THROUGH-PENETRATION FIRESTOPPING MATERIALS

A. General: Listed manufacturers of through-penetration firestopping are intended as guidelines only; manufacturer and material type shall be as required by the UL Design No. for each penetration to receive firestopping.

B. Approved Manufacturers: Hilti Construction Chemicals, Inc., International Protective Coatings Corp., Specified Technologies, Inc., The RectorSeal Corporation, Tremco, Inc., 3M Fire Protection Products or approved equal.

C. Provide mortar, sealants and caulk, putty, wrap strips, pillows, bags, and other types required for UL Design No. for each penetration to receive firestopping.

2.03 MINERAL FIBER FIRESTOPPING MATERIALS

A. Material: Semirigid mineral fiber insulation, minimum 4-pcf density; USG Interiors "Thermafiber Safing", Johns Manville "Insul-Shield", Thermal Ceramics Inc. "Cerablanket F.S" or approved equal.

B. Foil-Faced Curtain Wall Insulation: Hilti Firestop Systems, USG Fire Stop Systems “Foil-Faced Thermafiber Curtain Wall” or “FireSpan Insulation” or approved equal, 2-inch thick, 8-pcf density.

C. Support Clips: Manufacturer's standard impaling clips or custom designed to suit installation conditions, fabricated from galvanized sheet steel.

D. Smoke Sealant: Thermafiber “Smoke Seal Compound”, “Firecode Compound” or “Fire Barrier”, Specified Technologies Inc. “SpecSeal AS200 Elastomeric Spray” or “SpecSeal Fast Track Spray”, 3M “FireDam 100 Spray” or as indicated in the applicable UL Design No. for required fire-rating.

2.04 FIRESTOPPING AT ELECTRICAL BOXES AND UTILITY OUTLETS

A. Utility penetrations in walls, ceilings, or floors requiring protected openings shall be firestopped and sealed with an approved material securely installed, capable of maintaining its integrity when subjected to test temperatures specified in ASTM E814.

B. Steel electrical outlet boxes on opposite sides of walls requiring protected openings shall be separated by a horizontal distance of 24-inches.

C. Steel electrical outlet boxes which occur in combination with outlet boxes of any size such that the aggregate area of unprotected outlet boxes exceeds 100-square inches in any 100-square feet of wall area shall be protected by an approved material or detail to decrease the aggregate area of unprotected utility boxes to less than 100-square inches in any 100-square feet of wall.

D. Steel electrical outlet boxes which exceed 16-square inches in area shall be protected by 3M "Moldable Putty Pads", Specified Technologies, Inc. "SpecSeal Series SSP Putty Pads" or approved equal.

E. Utility and electrical outlets or boxes shall be securely fastened to the stud or framing of the wall or ceiling

assembly. The opening in the gypsum board shall be cut so that the clearance between the box and the gypsum board does not exceed 1/8-inch.

1. Fill the 1/8-inch gap with an approved fire-rated sealant.

2.05 FIRESTOPPING AT METAL DECK FLUTES

A. Steel Deck Insert: Fyre Sleeve Industries, Inc., “Q-Stop” or approved equal one-piece fire-retardant plug for steel deck flutes.

B. Fire-Rated Sealant: Grace Construction Products “FS-3000”, Hilti “CP-672 Speedspray”, 3M “Firedam Spray”, Tremco “Tremstop Acrylic” or approved equal.

C. Mineral Wood: Minimum 4-pcf density.

2.06 MIXING

A. For those products requiring mixing prior to application, comply with manufacturer's instructions.

2.07 ESCUTCHEONS

A. Provide brushed stainless steel escutcheon plates at pipes and conduit exposed to view. Size to suit penetration.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect openings and voids to be sealed to determine if conditions are satisfactory for the proper installation of firestopping. Do not commence work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer.

1. Remove foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping.

3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by manufacturer using manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of the work. Remove tape as soon as possible.

3.03 EXTENT OF FIRESTOPPING WORK

A. General: Provide solid continuous firestopping wherever the penetration or addition of a construction element through or adjacent to a fire-rated floor, wall or partition, or roof creates a discontinuity of such a rated separation. Application limited in size and configuration to tested systems. Do not install insulation types specified in other Sections in lieu of specified firestopping materials.

B. Building Exterior Perimeters:

1. Provide mineral fiber type firestopping for full depth of structural floor, filling spaces resulting where exterior facing construction continues past a structural floor.

2. Provide whether or not there are clips, angles, plates, or other members bridging or interconnecting the exterior wall and floor systems, and whether or not such items are continuous.

C. Interior Walls and Partitions: Where top edge of a fire-rated wall or partition abuts a fluted-type metal deck, provide mineral fiber and fire-rated sealant to fill flute spaces for the full depth or width of the wall or partition.

D. Penetrations:

1. Penetrations include conduit, cable, wire, pipe, duct, and other elements which pass through one or both outer surfaces of a fire-rated floor, roof, wall, or partition.

2. Verify that annular space around sprinkler pipes through fire-rated walls and floors is provided as required by NFPA 13.

E. Fire Rated Partitions:

1. Gaps exceeding 1/2-inch at smoke rated and fire-rated partitions shall be firestopped with a firestop sealant as listed in UL "Fire Resistance Directory" and as specified. Apply minimum 3/8-inch bead at intersection of finish material and adjacent surface, both sides and along entire perimeter.

2. Intersections at fire-rated partitions and steel deck type floor-ceiling or roof-ceiling assemblies shall be firestopped as required.

F. Provide firestopping to fill miscellaneous voids or openings at fire-rated construction as specified.

3.04 INSTALLATION

A. Do not install firestopping until building is sufficiently enclosed or protected against adverse weather conditions, applied fireproofing work, including repairs, has been completed, and supporting framing and surrounding construction is in a dry condition.

B. Prepare and install firestopping in accordance with manufacturer's instructions.

C. Mineral Fiber:

1. Provide in thickness for compressing into voids for a tight friction fit when installed.

2. Provide in width sufficient to fill the depth of the void space using single width pieces.

3. Install with ends tight against terminal end construction, and with intermediate joints well compressed together and tight.

4. For vertical void spaces, provide support clips near each end, spaced not over 24-inches on center.

D. Building Perimeter Firestopping:

1. Install firestopping of proper width in safe-off area on safing clips spaced 12- to 24-inches on center or as recommended by firestopping manufacturer, leaving no voids. Cut firestopping wider than opening to ensure compression fit.

2. Where required by UL Design No., install smoke sealant in accordance with manufacturer's instructions and as required by UL Design No. Cover the exposed surface of the mineral wool with a wet film thickness of 1/8-inch and overlap the material a minimum of ½-inch onto the adjacent curtain wall assembly and concrete floor slab. If the spray process is stopped and the applied liquid cures to an elastomeric film before the process is restarted, overlap the edge of the cured material at least 1/8-inch with the spray.

E. Foam:

1. Provide form materials to retain foam when placed.

2. Prime contact surfaces as recommended by foam manufacturer.

3. Inject foam into void spaces so foam develops full and complete contact with adjoining surfaces, and the space is free from air pockets.

4. Cure foam 24-hours, remove form materials not required to remain, and inspect.

5. Provide additional foam or sealant to fill insufficient depth and remaining voids.

F. Sealants:

1. Prepare penetrations in vertical and horizontal surfaces as required to receive finish products.

2. Install damming materials as required.

3. Apply caulk or putty in accordance with manufacturer's recommendations.

G. Steel Deck Plugs: Provide at steel deck flutes at all full-height sound-rated partitions unless otherwise indicated.

H. Finish surfaces of exposed to view firestopping to a uniform and level condition.

I. Firestopping shall not extend past edges of cover plates, escutcheons, etc. or where it will be exposed to view in the final assembly.

J. Install escutcheon plates at pipes and conduit exposed to view.

3.05 FIELD QUALITY CONTROL

A. Identify firestop systems after installation. Identify the firestop system that has been installed and include the appropriate UL Design Number.

B. At fire-rated walls, partitions, smoke barriers and other walls required to have protected openings or penetrations, provide a sign or stenciling on each side of the wall above the accessible ceiling stating that penetrations through fire-rated walls and partitions are not permitted unless such penetrations or openings are protected with firestopping meeting code requirements. Letters shall not be less than 1/2-inch in height. Repeat at intervals not exceeding 10-feet measured horizontally. Signs or stenciling shall comply with CBC Section 703.6 requirements.

3.06 CLEANING

A. Remove spilled and excess materials without damaging adjacent surfaces.

B. Leave finished work in neat, clean condition with no evidence of spill-overs or damage to adjacent surfaces.

3.07 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperatures.

C. Place used sealant tubes and containers in areas designated for hazardous materials.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing joint sealants.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Firestopping sealants are specified in Section 07 84 00.

3. Joint sealants related to flashing and sheet metal work are specified in Section 07 62 00.

4. Acoustical joint sealants are specified in Section 07 92 19.

5. Glazing sealants are specified in Section 08 80 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's technical data for each product required, including instructions for joint preparation and sealant application. Include certification by joint sealant manufacturer that sealants, primers, and cleaners comply with local regulations controlling the use of volatile organic compounds (VOC). Include tested physical and performance properties. Include data sheets for substrate cleaners and substrate primers recommended by sealant manufacturer for specific substrate surface conditions.

C. Joint Sealant Schedule: Include the following information:

1. Joint sealant application and typical joint locations to receive sealants.

2. Joint sealant manufacturer and product name.

3. Joint sealant formulation and color.

D. Samples: Manufacturer's bead samples of actual products showing full range of colors for each product exposed to view, including custom colors if required.

E. Test Reports:

1. Certified test results of elastomeric sealants showing compliance with specified requirements. Include results of aged performances including hardness, stain-resistance, adhesion and cohesion under cyclic movement, low temperature flexibility, modulus of elasticity at 100-percent strain, affects of heat and aging, and affects of accelerated weathering.

2. Preconstruction field test results indicating which products and joint preparation methods demonstrated acceptable adhesion to joint substrates.

F. Certificates: Manufacturer's certification that joint sealants comply with specified requirements and are suitable for uses indicated.

G. Installer qualifications.

H. Warranty.

1.03 QUALITY ASSURANCE

A. Installer's Qualifications: Approved by the sealant manufacturer with a minimum of 5-years' experience on Projects of similar scope and scale.

B. Obtain joint sealant materials from a single manufacturer for each product required unless otherwise approved.

C. Preconstruction Field Testing: Prior to installation of joint sealants, field-test adhesion to joint substrates.

2. Install joint sealants in 5-foot joint lengths. Allow to cure before testing. Test adhesion by pulling sealant out of joint according to "Method A, Field-Applied Sealant Joint Hand Pull Tab", in Appendix X1 in ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Perform field tests for each type of elastomeric sealant and joint substrate.

4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.

5. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.

6. Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrate during testing.

D. Pre-installation Meeting: Conduct at the Project site to review requirements for sealant work.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver materials in the unopened, original containers or unopened packages with manufacturer's name, labels, product identification, color, expiration period, curing time and mixing instructions for multi-component materials.

C. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturers. Store materials in a clean, dry protected location on raised platforms with weather-protective coverings, within temperature range required by sealant manufacturer.

D. Protect stored materials from direct sunlight.

E. Sealant manufacturer's standard packaging and covering is not considered adequate protection.

1.05 PROJECT CONDITIONS

A. Environmental Conditions: Do not install sealants when ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or to wet joint substrates.

B. Joint Width Conditions: Do not install sealants when joint widths are less than permitted by sealant manufacturer.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.06 WARRANTY

A. Exterior Sealants: Furnish a written warranty against leaks or other defects of materials and workmanship for a period of 10-years. Defects include but are not limited to changes in the structural, physical or chemical properties of the sealant materials that impair function or require abnormal maintenance, changes in surface finish, color or texture, failure in adhesion, weather resistance or durability, failure to prevent entry of water, or failure to comply with specified requirements.

B. This warranty shall not cover formation of cracks or defects in substrate materials adjacent to the seal, joint movement in excess of movement rating of sealant, or physical damage caused by others.

C. Repair or replace defective materials and workmanship during warranty period without expense to Owner, including removal and replacement of other items as required.

D. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Provide color of exposed joint sealants as selected by Architect. Custom colors will be used.

B. Provide joint sealers, joint fillers and other materials that are compatible with one another and with joint substrates, as demonstrated by testing and field experience.

2.02 ELASTOMERIC JOINT SEALANTS

A. Exterior Building Sealant: Either one-part silicone complying with ASTM C920, Type S, Grade NS, Class 25, 50 or 100 depending on product used, Use NT, M, A, and O or multi-component polyurethane complying with ASTM C920, Type M, Grade NS, Class 25, Use NT, M, A, and O. Dow Corning Corp. "790" or "795", Tremco "Spectrem 1" or approved equal. Sealant shall resist ultra-violet, heat, ozone and moisture exposure and shall withstand substrate surface temperatures as high as 250-deg. F. and a surface temperature range of 150-deg. F.

B. Sanitary Sealant: One-part mildew-resistant silicone; ASTM C920 Type S; Grade NS; Class 25; Uses NT, G, A and O; formulated with fungicide for sealing interior joints with nonporous substrates around ceramic tile, showers, sinks and plumbing fixtures; Dow Corning Corp. "786 Mildew Resistant", General Electric Co. "Sanitary 1700", Sonneborn Building Product Div. "Sonolastic Omniplus", Tremco Tremsil 200 or approved equal.

C. Horizontal Joint Sealant: Two-part pourable urethane; ASTM C920, Type M; Grade P; Class 25; Uses T, M, A and O; Pecora Corp. "NR-200 Urexpan", Sonneborn "Sonolastic Paving Joint Sealant", Tremco, Inc. "THC-900/901" or approved equal. Horizontal joint sealant shall have a minimum Shore A hardness of 30.

2.03 LATEX JOINT SEALANTS

A. Interior Building Sealant: Acrylic-emulsion; one-part, nonsag, mildew-resistant, complying with ASTM C834, formulated to be paintable; Pecora Corp. "AC-20", Sonneborn "Sonolac", Tremco Inc. "Tremco Acrylic Latex 834" or approved equal.

2.04 JOINT FILLERS FOR CONCRETE PAVING

A. Joint Filler: Preformed cork strips complying with ASTM D1752 for Type II or preformed sponge rubber strips complying with ASTM D1752 for Type I.

2.06 JOINT SEALANT BACKING

A. General: Provide sealant backings which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved by sealant manufacturer.

B. Plastic Foam Joint-Fillers: Preformed, compressible, resilient, non-waxing, non-extruding strips of plastic foam, of size, shape and density to control sealant depth.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer. Provide self-adhesive tape where applicable.

2.07 MISCELLANEOUS MATERIALS

A. Primer: As recommended by joint sealant manufacturer for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.

C. Masking Tape: Non-staining, non-absorbent type compatible with joint sealants and to surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust, paints, oil, grease, waterproofing, water repellents, water, and surface dirt.

2. Clean porous surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or acid washing to produce a clean, sound substrate. Remove loose particles remaining from cleaning operations by vacuuming or blowing out joints.

3. Remove laitance and form release agents from concrete.

4. Clean non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond, do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces. Remove tape immediately after tooling without disturbing joint seal.

3.02 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply. Provide temporary ventilation during installation of interior joint sealants.

B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint-fillers to provide sealant support for optimum performance cross-sectional shapes and depths.

a. Do not leave gaps between ends of joint-fillers.

b. Do not stretch, twist, puncture or tear joint-fillers.

c. Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.

D. Installation of Sealants: Install sealants by proven techniques to contact and fully wet joint substrates, completely filling recesses provided for each joint configuration and providing uniform, optimum performance cross-sectional shapes and depths.

E. Tooling of Non-sag Sealants: Tool sealants to form smooth, uniform beads of slightly concave profile that is slightly below the adjacent surfaces unless otherwise indicated. Tool to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents.

3.03 PROTECTION AND CLEANING

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage.

B. Cut out and remove damaged or deteriorated joint sealers and reseal joints with matching new materials.

C. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by sealant manufacturer.

3.04 FIELD QUALITY CONTROL

A. Conduct field adhesion testing in accordance with ASTM C1521 with the sealant manufacturer's representative present. Conduct 10 tests in the first 1,000-feet of each sealant type and substrate followed by 1 test for every 1,000-feet thereafter if no test failure occurs.

3.05 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperatures.

C. Place used sealant tubes and containers in areas designated for hazardous materials.

END OF SECTION

SECTION 07 92 19

ACOUSTIC JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing joint sealants.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Firestopping sealants are specified in Section 07 84 00.

3. Joint sealants related to flashing and sheet metal work are specified in Section 07 62 00.

5. Glazing sealants are specified in Section 08 80 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's technical data for each product required, including instructions for joint preparation and sealant application. Include certification by joint sealant manufacturer that sealants, primers, and cleaners comply with local regulations controlling the use of volatile organic compounds (VOC). Include tested physical and performance properties. Include data sheets for substrate cleaners and substrate primers recommended by sealant manufacturer for specific substrate surface conditions.

C. Joint Sealant Schedule: Include the following information:

1. Joint sealant application and typical joint locations to receive sealants.

2. Joint sealant manufacturer and product name.

3. Joint sealant formulation and color.

D. Samples: Manufacturer's bead samples of actual products showing full range of colors for each product exposed to view, including custom colors if required.

E. Test Reports:

1. Certified test results of elastomeric sealants showing compliance with specified requirements. Include results of aged performances including hardness, stain-resistance, adhesion and cohesion under cyclic movement, low temperature flexibility, modulus of elasticity at 100-percent strain, effects of heat and aging, and effects of accelerated weathering.

2. Preconstruction field test results indicating which products and joint preparation methods demonstrated acceptable adhesion to joint substrates.

F. Certificates: Manufacturer's certification that joint sealants comply with specified requirements and are suitable for uses indicated.

G. Installer qualifications.

H. Warranty.

1.03 QUALITY ASSURANCE

A. Installer's Qualifications: Approved by the sealant manufacturer with a minimum of 5-years' experience on Projects of similar scope and scale.

B. Obtain joint sealant materials from a single manufacturer for each product required unless otherwise approved.

C. Preconstruction Field Testing: Prior to installation of joint sealants, field-test adhesion to joint substrates.

2. Install joint sealants in 5-foot joint lengths. Allow to cure before testing. Test adhesion by pulling sealant out of joint according to "Method A, Field-Applied Sealant Joint Hand Pull Tab", in Appendix X1 in ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Perform field tests for each type of elastomeric sealant and joint substrate.

4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.

5. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.

6. Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrate during testing.

D. Pre-installation Meeting: Conduct at the Project site to review requirements for sealant work.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver materials in the unopened, original containers or unopened packages with manufacturer's name, labels, product identification, color, expiration period, curing time and mixing instructions for multi-component materials.

C. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturers. Store materials in a clean, dry protected location on raised platforms with weather-protective coverings, within temperature range required by sealant manufacturer.

D. Protect stored materials from direct sunlight.

E. Sealant manufacturer's standard packaging and covering is not considered adequate protection.

1.05 PROJECT CONDITIONS

A. Environmental Conditions: Do not install sealants when ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or to wet joint substrates.

B. Joint Width Conditions: Do not install sealants when joint widths are less than permitted by sealant manufacturer.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.06 WARRANTY

A. Exterior Sealants: Furnish a written warranty against leaks or other defects of materials and workmanship for a period of 10-years. Defects include but are not limited to changes in the structural, physical or chemical properties of the sealant materials that impair function or require abnormal maintenance, changes in surface finish, color or texture, failure in adhesion, weather resistance or durability, failure to prevent entry of water, or failure to comply with specified requirements.

B. This warranty shall not cover formation of cracks or defects in substrate materials adjacent to the seal, joint movement in excess of movement rating of sealant, or physical damage caused by others.

C. Repair or replace defective materials and workmanship during warranty period without expense to Owner, including removal and replacement of other items as required.

D. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 ACOUSTICAL SEALANT (At Sound-Rated Constructions)

A. Acoustical sealant shall be non-skinning, non-hardening, flexible sealant specifically designed for sealing gypsum wallboard. Sealant shall be capable of spanning 1/2-inch wide by 3/8-inch deep gaps. Synthetic rubber based products comply with ASTM Standard D-217 and acrylic latex based products comply with ASTM Standard C-834.

Acceptable Products: for concealed joints Tremco (800-321-7906), Pecora BA-98, and for exposed joints: Pecora AC-20 FTR (800-523-6688), USG acoustical sealant, or approved equivalent.

B. Sheet caulking for junction boxes: "Lowry's Electrical Box Sealer" (800-772-2521), or Tremco sheet caulking (800-321-7906). Sheet caulking for junction boxes at fire-rated assemblies: "Firestop Putty Pads" by Hevi-duty/Nelson (800-331-7325), Specified Technologies, Inc. (800-992-1180), or HILTI CP-617 (800-879-8000).

C. Backing Rod: Closed-cell, neoprene rod or polyethylene foam.

D. Expanding Foam Sealant: UL Class 1 fire retardant - Polycell expanding foam by Macklanburg Duncan (800-348-3571), Great Stuff Pro – Gaps & Cracks by Dow (800-800-3626).

E. Cementitious sealant: Spray-applied (40 pcf) Monokote Z-146

F. Sprayed Acoustical Sealant: STI "SpecSeal Smoke 'N' Sound Acoustical Spray" or approved equal.

PART 3 - EXECUTION

3.01 USAGE

A. Use acoustical sealant to form an airtight seal at all penetrations and perimeter of sound-rated partitions, floors and ceilings. Comply with Section 09 21 16, Gypsum Board and ASTM C919. Use backer-rod where gaps to be sealed exceed 3/8-inch.

B. Use sheet caulking to seal the back and sides of all junction boxes (4 gang and smaller) recessed in sound-rated partitions.

C. Apply acoustical sealant as a continuous bead along gypsum board face layer at all head and sill conditions of sound-rated partitions and around the perimeter of resilient ceilings.

D. Apply expanding foam sealant where detailed and where multiple pipes or conduits penetrate sound-rated construction.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing hollow metal doors, door frames, interior window frames, transom panels, and associated accessories.

B. Related Sections:

1. Interior aluminum frames are specified in Section 08 11 16.

2. Flush wood doors are specified in Section 08 14 16.

3. Door hardware is specified in Section 08 71 00.

4. Glass and glazing is specified in Section 08 80 00.

5. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Furnish for each type of door and frame, including details of construction, materials, dimensions, hardware preparation, core, label compliance, profiles, and finishes.

C. Shop Drawings: Include details of each frame type, elevations of door types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items. Include details of moldings, removable stops and glazing. Reference architectural details, door number and hardware group.

D. Door Schedule: Furnish complete schedule of doors and frames using same reference numbers for details and openings as those on the drawings.

1.03 QUALITY ASSURANCE

A. Steel doors and frames shall comply with ANSI A250.8 "Recommended Specifications Standard Steel Doors and Frames" and the specified requirements.

B. Fire-Rated Doors: Provide hollow metal doors and frames that comply with California Building Code (CBC) Section 715; are identical in materials and construction to units tested in door and frame assemblies in accordance with NFPA 252 or UL 10C; and are labeled and listed by UL, Warnock Hersey, or other testing and inspection agency acceptable to authorities having jurisdiction. Labels shall comply with NFPA 80 and be permanently affixed to the door.

C. Hollow metal doors and frames shall comply with positive pressure test requirements of NFPA 252 or UL 10C and shall be labeled accordingly by the door and frame manufacturer in a manner approved by authorities having jurisdiction. Door label shall include hourly rating followed by the letter “S” indicating conformance with air leakage resistance testing, serial number, and the listing agency’s certification mark.

D. Temperature-Rise Rating: At exit enclosures and exitways, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure. In addition to the requirements specified for positive pressure test requirements in Paragraph D. above, the door label shall include temperature rise rating.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.

C. Inspect doors and frames upon delivery for damage. Minor damage may be repaired provided finish items

are equal to new work and acceptable to Architect; otherwise remove and replace damaged items as directed.

D. Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid use of non-vented plastic or canvas shelters that could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch space between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Amweld Hollow Metal Doors and Frames, Ceco Door Products, Curries Company, Stiles, Steelcraft or approved equal.

2.02 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A569.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A366, commercial quality or ASTM A620, drawing quality.

C. Galvanized Steel Sheets: Zinc-coated carbon steel complying with ASTM A526, commercial quality, or ASTM A642, drawing quality, hot dipped galvanized in accordance with ASTM A653, A60 or G90 coating designation, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 16-gauge, galvanized where used with galvanized frames.

E. Inserts, Bolts and Fasteners: Manufacturer's standard units. Where items are built into exterior walls, hot-dip galvanize in accordance with ASTM A153, Class C or D as applicable.

F. Shop Applied Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

G. Grout: Masonry grout complying with ASTM C476, except with a maximum slump of 4-inches as measured according to ASTM C143.

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

I. Inert Filler: Noncorrosive compound free of asbestos fibers, sulfur components and other deleterious impurities.

2.03 DOORS

A. Provide metal doors of ANSI A250.8 grades and models specified.

1. Interior Flush Doors: Level 2, heavy duty, Model 2 except minimum 16-gauge cold-rolled sheet steel faces.

2. Exterior Flush Doors: Level 3, extra heavy duty, Model 2, minimum 16-gauge galvanized steel faces.

B. Door Louvers: Sight-proof stationary louvers, constructed of inverted V-shaped or Y-shaped blades formed of 24-gauge cold-rolled steel set into minimum 20-gauge steel frame. Provide galvanized louvers and frames in exterior doors.

C. Internal Construction: Unitized steel grid or vertical steel stiffeners with core sound deadener on inside of face sheets, in accordance with ANSI A250.8 requirements.

1. At fire-rated doors, provide core material as required to provide fire-protection and temperature-rise ratings.

D. Clearance: Not more than 1/8-inch at jambs and heads. Not more than 3/8-inch at bottom. Threshold

clearances as indicated.

1. Fire Doors: Provide clearances according to their listing except where more stringent requirements are specified.

E. Edges:

1. General: Beveled latch stile for single doors, and meeting stile for pair doors; square elsewhere.

2. Stile Edges: No seams are allowed on vertical stile edges.

3. Top and Bottom Edges: Reinforced with 16-gauge steel channels; both edges flush and made watertight for exterior doors, top edge flush for interior doors.

F. Glazing: Provide minimum 20-gauge steel non-removable glazing stops on the outside of exterior doors and on the secure side of interior doors. Glazing beads on the inside of glass panels shall be removable. Glazing beads shall be fabricated from the same materials as door face sheets.

2.04 DOOR FRAMES

A. One-Piece Welded Frames: 16-gauge. Fabricate frames with mitered or coped and continuously welded corners.

B. Glazing Beads: Provide frame glazing beads in interior glazed openings and other locations where fixed glass is indicated. Prepare frames for the type of glazing beads required to receive the glass and gaskets indicated. Miter or butt join beads at corners. Glazing beads shall be screw-on type to receive countersunk flat head machine screws spaced not more than 9-inches on center and not more than 2-inches from each corner. Glazing installation shall comply with Section 08 80 00.

C. Anchors:

1, Provide jamb anchors spaced not more than 32-inches on center and locate anchors not more than 18-inches from top and bottom of frame.

2. Fabricate from minimum 16-gauge sheet steel.

3. Vary anchor types to provide positive fastening to adjacent construction.

4. Secure a metal clip angle at bottom of each jamb member for anchoring to floor, with a minimum of two fasteners.

5. Items to be built into exterior walls shall be hot-dip galvanized after fabrication in accordance with ASTM A153, Class B.

D. Door Silencers: Except on weatherstripped or smoke gasketed frames, drill stops to receive 3-silencers on strike jambs of single-swing frames and 2-silencers in heads of double-swing frames.

E. Plaster Guards: Provide 26-gauge steel plaster guards or mortar boxes at back of hardware cutouts.

F. Where frames are to be grouted with grout containing anti-freeze admixtures, coat inside of frame with a bituminous water-resistant paint prior to installation. Bituminous water-resistant paint shall not affect the fire-rating of the frame. Fabricate frames to be grouted with flowable grout with grout holes at top of each jamb. Provide additional grout holes as required to fill internal obstructions. Tape plugs to frames. Install grout protection guards at lock preparations and tapped mounting holes. Do not use flowable grout in metal frames installed in metal stud walls.

2.05 FABRICATION

A. Fabricate steel doors and frames to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at Project site. Comply with ANSI A250.8 requirements.

B. Fabricate exposed faces of doors, including stiles and rails of non-flush units, from cold-rolled steel.

C. Tolerances: Comply with SDI-117, "Manufacturing Tolerances Standard Steel Doors and Frames" unless otherwise indicated or specified.

D. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.

E. Fabricate exterior doors and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gauge inverted steel channels with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.

F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat heads for exposed screws and bolts.

G. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A250.6 for door frame preparation for hardware.

1. For concealed overhead door closers, provide space, cutouts, reinforcing and provisions for fastening in top rail of doors or head of frames, as applicable.

H. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping of surface-applied hardware may be done at Project site.

I. Locate hardware as indicated on final shop drawings and in accordance with Door Hardware Institute (DHI) "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames".

J. Shop Painting: Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive paint finish.

3. Primer shall comply with ANSI/SDI 250.3 and shall be compatible with substrate and field-applied finishes despite prolonged exposure.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install steel doors, frames, and accessories in accordance with the manufacturer's instructions, the requirements of ANSI/SDI, and final reviewed Shop Drawings.

B. Placing Frames: Comply with provisions of ANSI A250.8 and SDI-112 unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Except for frames located in concrete, place frames before constructing enclosing walls or ceilings.

2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hing jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

3. At existing concrete or masonry construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.

4. In stud partitions, install at least 4 wall anchors per jamb at hinge and strike levels. Attach wall anchors to studs with screws.

5. Install fire-rated frames according to their listings.

6. Install head anchors at mid span for openings exceeding 48-inches.

7. Where indicated, frames shall be fully grouted to provide added protection against battering, wedging, spreading and other mean of forcing open the door. Grout frames using specified grout. At interior grouted frames in metal stud walls, install grout before frame installation and do not grout the bottom 6-inches of the frame to prevent wicking of water and do not prevent the gypsum board from entering the throat of the jamb the required distance to achieve the fire rating on labeled openings. Where flowable grout is used, after grouting, weld grout hole plugs in place and grind smooth, flush and imperceptible in the completed work. Touch-up primer. Remove grout from frames and door surfaces immediately following installation.

C. Door Installation: Fit hollow metal doors accurately in frames, within specified clearances.

1. Fire-Rated Doors: Install with clearances specified in their listings and as specified

3.02 ADJUST AND CLEAN

A. Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

1. Remove rust before touch-up is applied.

2. Touch-up shall not be obvious.

B. Repair damaged galvanizing with a galvanizing repair paint.

C. When complete, exposed surfaces and edges shall be clean, straight, and free from dents, scratches, and other damage and defects.

D. Doors and finish hardware shall operate smoothly, quietly, and free from bind.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing flush wood doors.

B. Related Sections:

1. Interior architectural woodwork is specified in Section 06 40 23.

2. Hollow metal doors and frames are specified in Section 08 11 13.

3. Finish hardware is specified in the drawings.

4. Glass for vision panels is specified in Section 08 80 00.

6. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's descriptive and technical data and illustrations for each type of door including details of core and edge construction, and trim for openings.

C. Shop Drawings: Indicate location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other data.

1. Shop drawings shall comply with AWS Section 1 – Submittals.

2. Furnish a Woodwork Institute “Certified Compliance Label” on the first page of the shop drawings.

D. Samples:

1. Submit 24-inch square or larger samples as specified or required to represent required characteristics. Resubmit samples until approved.

a. Doors for Transparent Finish: Door faces with solid wood edging representing typical range of color and grain for each species of veneer. Samples shall be representative of the complete range of wood veneer colors to be expected in the work.

2. Furnish full-size door for transparent finish showing the complete range of color and grain to be expected in the completed work. Resubmit until sample is approved by the Architect. Approved sample will be used to judge the acceptability of transparent finished door veneer and may be used in the Project.

E. Warranty.

1.03 QUALITY ASSURANCE

A. Flush wood door construction shall comply with Architectural Woodwork Standards (AWS) for Premium grade doors.

B. Fire-Rated Doors: Provide wood doors that comply with California Building Code (CBC) Section 715; are identical in materials and construction to units tested in door and frame assemblies in accordance with NFPA 252 or UL 10C; and are labeled and listed by UL, Warnock Hersey, or other testing and inspection agency acceptable to authorities having jurisdiction. Labels shall comply with NFPA 80 and be permanently affixed to the door.

C. Allowable Tolerances:

1. Warp Tolerance: As specified in Section WDMA T-2. In addition, warp tolerance shall apply to pairs of doors and to doors in relation to the frame or jamb in which hung.

2. Squareness: WDMA T-3.

3. Gap Tolerance: As specified in Architectural Woodwork Standards Section 9, Section 4.3.8 and Section 6.1.20.

4. Flushness of Joinery: As specified in Architectural Woodwork Standards Section 9, Section 6.1.21.

D. Flush wood doors and steel frames specified in Section 08 11 13 shall comply with positive pressure test requirements of NFPA 252 or UL 10C and shall be labeled accordingly by the door and frame manufacturer in a manner approved by authorities having jurisdiction. Door label shall include hourly rating followed by the letter "S" indicating conformance with air leakage resistance testing, serial number, and the listing agency's certification mark.

E. Temperature-Rise Rating: At exit enclosures and exitways, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure. In addition to the requirements specified for positive pressure test requirements in Paragraph D. above, the door label shall include temperature rise rating.

F. WI Certified Compliance Program (CCP):

1. Before delivery to the Project site, provide a Woodwork Institute Certified Compliance Certificate itemizing the products to be provided and certifying that they meet the requirements of the Architectural Woodwork Standards and of the Plans and Specifications.

2. Upon completion of installation, furnish a WI Certified Compliance Certificate for the installation.

3. In the event of question as to compliance with the referenced standard of any item of work, the Architect may require independent inspection service of questioned items as specified in "Independent Inspection Service" of WI "Services and Quality Control Options" published by the WI.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver doors individually protected with polyvinyl or plastic wrap, identified with manufacturer's name, and name and type of door. Identify each door with same symbol used on door schedule. Leave protection on door during construction.

1. Comply with Architectural Woodwork Standards (AWS) – Section 2 for delivery, storage, and handling of doors.

C. Store doors covered and flat, supported above a level surface in a dry, well ventilated building in compliance with Architectural Woodwork Standards (AWS) – Section 2.

D. Do not subject doors to extremely high or low temperatures or humidity.

E. Handle with clean gloves; do not drag doors across one another or other surfaces.

F. Certain wood species are light sensitive. Protect doors from exposure to natural and artificial light after delivery.

1.05 PROJECT CONDITIONS

A. Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during the remainder of construction period in compliance with the requirements specified in Architectural Woodwork Standards (AWS) – Section 2.

1.06 WARRANTY

A. Warrant each solid core interior door against defects in materials and workmanship for the life of the original installation, including costs of re-hanging. Defects include, but are not limited to the following:

1. Cores shall not telegraph through door faces. Stile, rail, and core show-through shall be considered a defect when the face of the door varies from a true plane in excess of 0.010-inch in a 3-inch span.

2. Doors shall not have warped (bow, cup, or twist) more than that permitted in Architectural Woodwork Standards (AWS) Section 6.1.21.

B. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Algoma Hardwoods, Inc., Eggers, Graham, Marshfield Door Systems, VTI, Western Oregon Door or approved equal.

2.02 FLUSH WOOD DOORS, GENERAL

A. Type: Flush veneered, five-ply construction. Doors with seven-ply construction will not be acceptable.

B. Door Grade:

1. Fabricate flush wood doors to receive transparent finish in accordance with Architectural Woodwork Standards (AWS), Premium Grade.

2. Fabricate flush wood doors to receive opaque finish in accordance with Architectural Woodwork Standards (AWS), Custom Grade.

C. Cross Banding: Manufacturer's standard, minimum 1/16-inch thick. Fire-retardant treated where required by testing agency.

D. Door Thickness: 1-3/4-inches, unless otherwise indicated.

E. Fabricate wood doors in sizes indicated for either job-site fitting or factory fit doors to suit frame-opening sizes indicated, at the Contractor's option. Doors shall comply with the following uniform clearances and bevels:

1. Non-rated Doors:

a. Jambs and Heads: 1/8-inch.

b. Meeting Stiles of Pairs of Doors: 1/8-inch.

c. Bottom of Door to Top of Finish Floor: 1/2-inch at concrete and resilient flooring, 3/8-inch at carpet, tile, threshold and other finish flooring.

2. Fire-rated Doors: Comply with requirements of CBC Section 715 and NFPA 80.

F. For doors that are pre-machined, factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory machining.

G. Factory Finishing:

1. Doors to be Field Painted: Prime paint doors suitable for field painting as specified in Section 09 91 00. Seal cut-outs, edges, and other surfaces not otherwise finished.

2. Transparent Finish Doors: Pre-finish to match Architect approved samples as follows:

a. Architectural Woodwork Standards (AWS) Section 5, Premium Grade.

b. Finish: Manufacturer's standard finish with performance requirements comparable to Architectural Woodwork Standards (AWS) Section 5, System 12 – Polyurethane, Water-Based, complying with VOC requirements.

c. Staining: Match Architect approved sample.

d. Effect: Filled finish.

e. Sheen: Satin, 31- to 45-degrees.

2.03 INTERIOR FLUSH WOOD DOORS

A. Veneer:

1. Transparent Finish Doors

a. Veneer Species and Grade: Architectural Woodwork Standards (AWS) Grade AA, White Birch, quarter sawn.

b. Veneer Matching: Book and center balance matching.

c. Pairs and Sets: Provide pair matching and set matching for pairs of doors and for doors hung in adjacent sets.

d. Doors in same room or area shall be matched for color and grain.

2. Painted Doors:

a. Veneer Species and Grade: Architectural Woodwork Standards (AWS) Grade A, Birch or other close grain hardwood.

B. Adhesive: NWWDA IS-1.6, Type II adhesive bond or better for cores, Type I adhesive bond for faces and cross bands.

C. Cores:

1. 20-Minute Fire-Rated Doors and Non-rated Doors (PC-5): Solid particleboard conforming to ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde resin.

2. Fire-Rated Doors Greater than 20-Minute Rated (FD-5): Incombustible mineral approved by labeling authority. Provide top, bottom, and intermediate blocking for surface-mounted hardware.

3. Where the distance between the lock cutout and the vision lite cutout require, provide door manufacturer’s structural composite lumber core (SCLC-5). Notify the Architect if the vision lite size and lock location exceeds door manufacturer’s maximum dimension.

D. Edge Construction:

1. 20-Minute Fire-Rated Doors and Non-rated Doors:

a. Stiles and Rails: Minimum 1-3/8-inch wide by full core thickness glued to core. Provide wider hinge stile where recommended by door manufacturer for door size and type of hinges to be used. Exposed edges of stiles shall be smooth, straight cut, free from knots, pitch pockets, and other defects for a minimum distance of 1/4-inch from the outside edge along the entire stile.

b. Species:

1) Stiles:

a) Same species as face for doors to receive transparent finish with no finger joints permitted on lock stiles.

b) Close-grain hardwood for doors to receive paint finish.

2) Rails: Hardwood or softwood at manufacturer's option.

c. Edge Banding: Minimum 1/2-inch wide by full core thickness. Edge bands if used may reduce the width of stiles and rails.

1) Species for doors to receive transparent finish shall be same as face with no finger joints permitted on lock stile.

2) Species for doors to receive paint finish shall be close-grain hardwood.

2. Fire-Rated Doors Greater than 20-Minute Rated:

a. Top Rail: Door manufacturer's standard special laminated material.

b. Stiles and Rails: Hardwood, fire-retardant treated where required by label. Where not required to be fire-retardant treated, provide same species for stiles as face veneer for doors to receive transparent finish. Sizes required by testing agency.

3. Bevel non-rated doors 1/8-inch in 2-inches at lock and hinge edges.

4. Bevel fire-rated doors 1/8-inch in 2-inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

2.04 DOOR LOUVERS

A. Type: Prefabricated 20-gauge steel units.

B. Opening Sizes: As scheduled.

C. Finish: Manufacturer's standard baked-enamel finish, of color selected by Architect.

2.05 LIGHT FRAMES

A. Non-Rated Doors and 20 Minute Fire-Rated Doors: Same wood species as door faces, profile as indicated.

B. Fire-Rated Doors over 20 minutes: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire ratings indicated. Include concealed metal glazing clips where required for opening size and fire ratings scheduled.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine door frames and verify that frames are of the correct type and have been installed as required for proper hanging of corresponding doors. Do not proceed with installation until unsatisfactory conditions have been

corrected.

3.02 PREPARATION

A. Condition doors to average prevailing humidity in installation area prior to hanging.

3.03 INSTALLATION

A. Install wood doors in accordance with the manufacturer's printed instructions, as indicated and in accordance with Architectural Woodwork Standards, Section 9.

B. Factory-finished doors shall be installed just prior to Substantial Completion.

C. Fire-Rated Doors: Install in fire-rated frames in accordance with requirements of NFPA Standard No. 80.

D. Job-Fit Doors: For doors not factory-machined, align and fit doors in frames with uniform clearances and bevels as specified; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Fitting Clearances:

a. Non-rated Doors:

1) Jambs and Heads: 1/8-inch.

2) Meeting Stiles of Pairs of Doors: 1/8-inch.

3) Bottom of Door to Top of Finish Floor: 1/2-inch at concrete and resilient flooring, 3/8-inch at carpet, tile, thresholds and other finish flooring.

b. Fire-rated Doors: As specified in CBC Section 715 and NFPA 80.

2. Bevel non-rated doors 1/8-inch in 2-inches at lock and hinge edges.

3. Bevel fire-rated doors 1/8-inch in 2-inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Cutouts, Recesses, and Exposed Rail Edges: Unless factory provided, paint with two coats of clear sealer, each coat well dried, before hardware is set in place.

G. Meeting stiles of pairs of doors shall be in alignment along the entire height, and offset between adjacent leaves shall not exceed 1/8-inch.

3.04 ADJUSTING AND PROTECTION

A. When complete, doors shall be flat within allowable tolerance, shall be plumb in all positions of swing, and shall operate smoothly, quietly, and free from binding. Re-hang or replace doors that do not swing or operate freely.

B. Exposed surfaces shall be uniform in appearance, clean and free from scratches, tool marks, dents, discoloration, stains, and other damage and defects.

C. Refinish or replace doors damaged during installation.

D. Protect doors as recommended by door manufacturer to ensure that doors will be without damage or deterioration at completion of Project.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing access doors at all required locations.

B. Related Sections:

1. Non-structural metal framing is specified in Section 09 22 16.

2. Metal suspension systems are specified in Section 09 22 26.23.

3. Gypsum board is specified in Section 09 29 00.

4. Gypsum board shaft wall assemblies are specified in Section 09 21 16.23.

5. Fire suppression work is specified in Division 21.

6. Plumbing work is specified in Division 22.

7. Heating, ventilating and air conditioning work is specified in Division 23.

8. Electrical work is specified in Division 26.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices. Include complete schedule including types, general locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions and other data pertinent to installation.

C. Location Drawing: Required access doors may not be indicated on the Drawings. Show proposed location of every required access door with dimensions in plan and elevation. Verify locations with the Architect. Access doors shall be located within walls and ceilings for access including but not limited to the following: automatic valves, automatic dampers, air terminal units, and fire/smoke dampers. Show location of adjacent materials, trim pieces, and hardware required to complete the work. Do not begin installation until location is approved. Submit access door locations superimposed on piping layout and duct layout shop drawings.

1.03 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Units shall comply with NFPA 80, be identical to door and frame assemblies tested for fire-test-response characteristics, and are labeled and listed by UL, Warnock Hersey, or other testing and inspecting agency acceptable to authorities having jurisdiction.

1.04 COORDINATION

A. Furnish inserts and anchoring devices required to be built into other work. Coordinate delivery to avoid delay.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver and store access doors in manufacturer's standard protective packaging.

C. Do not remove protective packaging until ready for installation.

D. Follow manufacturer's instructions for storage and handling.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Nystrom Building Products, J.L. Industries, Karp Associates, Milcor or approved equal.

2.02 MATERIALS AND FABRICATION

A. Furnish access doors of proper size for access to concealed equipment. Unless otherwise indicated, minimum size shall be 12-inch x 12-inch for hand access and minimum 18-inch x 18-inch for valve and actuator access and 24-inch x 24-inch for equipment access.

B. Non-Fire-Rated Access Doors with Exposed Trim:

1. Door Design: Flush panel.

2. Material: Commercial grade cold-rolled steel with 16-gauge frame and 14-gauge door.

3. Finish: Phosphate dipped with baked-on rust-inhibitive gray primer for field painting as specified in Section 09 91 00.

4. Exposed Trim: 1-inch flange overlapping surfaces surrounding door frame.

5. Hinge:

a. Locations Exposed to Public View: Concealed pin hinge mechanism. Exposed piano hinges are not acceptable.

b. Other Locations: Manufacturer's standard.

6. Latch/Lock: Flush screwdriver operated stainless steel cam latch. Provide keyed locks at access doors located in public areas.

C. Non-Fire-Rated Access Doors with Exposed Trim in Toilet Rooms, Custodial Rooms, and other Wet Areas:

1. Door Design: Flush panel.

2. Material: Stainless steel, 16-gauge frame and 14-gauge door.

3. Finish: Satin polish finish.

4. Exposed Trim: Flange integral with frame, 1-inch wide, overlapping surrounding finished surface.

5. Hinge:

a. Locations Exposed to Public View: Concealed pin hinge mechanism. Exposed piano hinges are not acceptable.

b. Other Locations: Manufacturer's standard.

6. Latch/Lock: Flush screwdriver operated stainless steel cam latch. Provide keyed locks at access doors located in public areas.

7. Provide insulated doors in insulated or acoustically rated construction.

D. Non-Fire-Rated Recessed Access Doors:

1. Door Design: Recessed to receive gypsum wallboard or other finish material as indicated.

2. Material: Cold Rolled sheet steel, 16-gauge, recessed 5/8-inch.

3. Frame: 16-gauge cold rolled sheet steel with 22-gauge galvanized perimeter drywall bead.

4. Hinge: Concealed pivoting rod.

5. Lock: Key operated cylinder lock with two keys per lock, keyed alike.

6. Finish: Phosphate dipped with baked-on rust inhibiting primer for field painting as specified in Section 09 91 00.

7. Provide insulated doors in insulated or acoustically rated construction.

E. UL Fire-Rated Access Doors with Exposed Trim:

1. Door Design: Flush panel.

2. Material: Commercial grade cold-rolled steel with 16-gauge frame and 20-gauge door.

3. Finish: Phosphate dipped with baked-on rust inhibiting primer for field painting as specified in Section 09 91 00.

4. Insulation: 2-inch thick fire-rated insulation sandwiched between two pieces of 20-gauge steel.

5. Exposed Trim: Flange integral with frame, 1-inch wide, overlapping surrounding finished surface.

6. Hinge:

a. Locations Exposed to Public View: Concealed pin hinge mechanism. Exposed piano hinges are not acceptable.

b. Other Locations: Manufacturer's standard.

7. Continuous Closer: Automatic spring closer to automatically close and latch door.

8. Latch/Lock: Ball bearing cylinder lock operated by a recessed flush key lock. Panels shall have interior latch release mechanism allowing the door to be unlocked from the inside. Provide keyed locks at access doors located in public areas.

F. UL Fire-Rated Access Doors with Exposed Trim at Toilet Rooms, Custodial Rooms, and Other Wet Areas:

1. Door Design: Flush panel.

2. Material: Stainless steel, 16-gauge frame and 20-gauge door.

3. Finish: Satin polish finish.

4. Insulation: 2-inch thick fire-rated insulation sandwiched between two pieces of 20-gauge steel.

5. Exposed Trim: Flange integral with frame, 3/4-inch wide, overlapping surrounding finished surface.

6. Hinge:

a. Locations Exposed to Public View: Concealed pin hinge mechanism. Exposed piano hinges are not acceptable.

b. Other Locations: Manufacturer's standard.

7. Continuous Closer: Automatic spring closer to automatically close and latch door.

8. Latch/Lock: Ball bearing cylinder lock operated by a recessed flush key lock. Panels shall have interior latch release mechanism allowing the door to be unlocked from the inside.

G. UL Fire-Rated Recessed Access Doors:

1. Door Design: Recessed to receive gypsum wallboard or other finish material as indicated.

2. Material: Cold Rolled sheet steel, 16-gauge, recessed 5/8-inch.

3. Frame: 16-gauge cold rolled sheet steel with 22-gauge galvanized perimeter drywall bead.

4. Hinge: Concealed pivoting rod. Exposed piano hinges are not acceptable.

5. Continuous Closer: Automatic spring closer to automatically close and latch door.

6. Latch/Lock: Ball bearing cylinder lock operated by a recessed flush key lock. Panels shall have interior latch release mechanism allowing the door to be unlocked from the inside. Provide keyed locks at access doors located in public areas.

7. Finish: Phosphate dipped with baked-on rust inhibiting primer for field painting as specified in Section 09 91 00.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install access doors in accordance with manufacturer's instructions.

B. Coordinate installation with work of other Sections.

C. Set frames accurately in position and securely attach to supports with face panels plumb and level in relation to adjacent finish.

D. Frames, doors and trim pieces shall not vary from straightness or snug contact fit by more than 1/16-inch.

E. Coordinate location of access doors in hung ceilings, furred spaces and walls to provide access to concealed work items requiring maintenance and/or adjustment. Obtain approval of the Architect for the locations of such access doors.

F. Locate and group equipment requiring access doors. Coordinate location of equipment with other trades to minimize number of access doors in one area.

G. Provide access doors for maintenance or adjustment purposes for mechanical system components, including but not limited to the following:

1. Valves.

2. Dampers.

3. Concealed equipment.

3.02 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels and frames that are warped, bowed, dented, or otherwise damaged.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Primary components of aluminum-framed entrances and storefronts include aluminum storefront framing, glass and glazing, sills and similar items indicated as integral components of the storefront system, joint sealants, flashings, anchors, shims, fasteners, accessories, and support brackets.

B. Related Sections:

1. Cold-formed metal framing is specified in Section 05 4 000.

2. Gypsum sheathing is specified in Section 06 16 43.

3. Self-adhering sheet flashing is specified in Section 07 65 26.

4. Joint sealants are specified in Section 07 92 00.

5. Glazed aluminum curtain walls are specified in Section 08 44 13.

6. Door hardware is specified in Section 08 71 00.

7. Glazing is specified in Section 08 80 00.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed entrances and storefronts that comply with performance characteristics specified, as demonstrated by testing the manufacturer's corresponding stock assemblies according to specified test methods. Entrances and storefronts shall accommodate movements and tolerances of the building structure, including but not limited to live load and dead load deflection, creep, seismic drift, and adjacent material tolerances.

B. Thermal Movement: Design the aluminum-framed entrances and storefronts to provide for expansion and contraction of the component materials resulting from a surface temperature range of 180-deg. F. without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects. Entrance doors and operable units shall function normally over the specified temperature range.

C. Structural Performance: Conduct tests for structural performance in accordance with ASTM E330. At the conclusion of the tests there shall be no glass breakage or permanent damage to fasteners, anchors, hardware or actuating mechanism. Framing members shall have no permanent deformation in excess of 0.2-percent of their clear span.

1. Deflection Normal to Plane of the Wall: Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the specified wind load. Deflection shall not exceed 1/175 of the clear span, when subjected to uniform load deflection test.

2. Deflection Parallel to the Plane of the Wall: Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 75-percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other fixed member above to less than 1/8-inch. The clearance between the member and an operable door or window shall be at least 1/16-inch.

3. Window Uniform Load Deflection: There shall be no deflection in excess of 1/175 of the span of any framing member with a minimum static air pressure difference of 65-psf applied in the positive and negative direction in accordance with ASTM E330.

4. Window Uniform Load Structural Test: A minimum static air pressure difference of 97.5-psf shall be applied in the positive and negative direction in accordance with ASTM E330.

E. Air Infiltration:

1. Provide aluminum-framed entrances and storefronts with an air infiltration rate of not more than 0.06-cfm per sq. ft. of fixed area, excluding operable door edges, when tested in accordance with ASTM E283 at an inward test pressure differential of 6.24-psf (50-mph wind load).

2. Windows: When closed and locked, air infiltration rate shall not exceed 0.10-cfm/ft. of vent perimeter when tested in accordance with ASTM E283 at a static air pressure differential of 6.24-psf.

F. Water Penetration:

1. Provide storefront framing systems with no uncontrolled water penetration, excluding operable door edges, as defined in the test method when tested in accordance with ASTM E331 at an inward test pressure differential of 6.24-psf.

2. Windows: When closed and locked, there shall be no leakage as defined in ASTM E547 and ASTM E331 at a static air pressure differential of 12-psf.

1.03 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Furnish product data for each system showing manufacturer's standard details and fabrication methods, data on finishing, hardware, and accessories, and recommendations for maintenance and cleaning.

C. Shop Drawings: Include for fabrication and installation, including large scale elevations, plans, full scale detail sections of typical members, anchors, reinforcement, expansion provisions, and glazing. Include full scale details at head, jambs, spandrels, sill and mullions for each opening.

1. Include structural analysis data signed and sealed by a qualified professional engineer, licensed in the State of California, responsible for their preparation. Clearly indicate all loads imposed on the primary building structure.

2. Indicate interface with adjacent construction and flashings.

3. Reference window types indicated on architectural window types drawings.

4. Reference architectural elevation, plans, sections and details.

5. Reference structural details and members.

6. Indicate flashings, brake shape trim and closures.

7. Show details of intersections of frame caps.

8. Show building dimensions and proposed methods to accommodate live load deflections and column shortening.

9. Show relative layout of walls, beams, columns and slabs. Indicate tolerances required for storefront installation that can be accommodated by the storefront system.

10. Show perimeter sealant joint sizes, including tolerances and minimum/maximum joint sizes required.

11. Show location of anchorage points and identification of the reaction loads imposed on the structure, including dead load and wind load reactions at each anchor location.

12. Show location of glass designated as fire break-out lites, location of decals used to identify glass, and decal design. Comply with local code requirements.

13. Show insulation materials, firestopping and fire safeing materials, vapor retarder materials.

14. Include Project-specific installation instructions and details. Include perimeter framing joint conditions and internal joinery conditions. Indicate which framing members run thru, and how joints are to be sealed. Indicate sealant continuity notches used to prevent water infiltration by capillary action in the metal-to-metal joint and internal seals.

C. Samples for Verification: Furnish two samples of each type and color of aluminum finish selected, on 12-inch long sections of extrusions or formed shapes and 6-inch square sheets.

D. Test Reports: Furnish certified test reports from a qualified independent testing laboratory showing that aluminum-framed entrances and storefronts have been tested in accordance with specified test procedures and comply with specified performance characteristics. Where such testing has not been performed, test through an independent testing laboratory or agency and furnish certified test results.

E. Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: A minimum of 5-years experience in the manufacture of aluminum-framed entrances and storefronts of the types specified.

B. Installer's Qualifications: Documented experience in the installation of systems similar to those required.

C. Single Source Responsibility: Provide aluminum-framed entrances and storefronts and windows produced by a single manufacturer.

D. Mockup: Prior to installing aluminum-framed entrances and storefronts, construct mockup for each form of construction and finish required to demonstrate aesthetic effects and qualities of materials and installation. Build mockup to comply with the following requirements:

1. Locate on-site in the location and size directed by the Architect.

2. Notify the Architect 7-days in advance of the dates and times when mockup will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Architect’s approval of mockups before beginning fabrication or ordering materials.

5. Retain and maintain mockup during construction in an undisturbed condition as a standard for judging the completed work. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed work.

6. Coordinate mockup work with work of other trades involved in combined mockup(s).

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver aluminum-framed entrances and storefronts in the manufacturer's original protective packaging.

C. Store aluminum components in a clean, dry location away from uncured concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.

1. Stack framing components in a manner that will prevent bending and avoid significant or permanent damage.

1.06 PROJECT CONDITIONS

A. Field Measurements: Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication with construction progress to avoid delay of the work.

1.07 WARRANTY

A. Furnish written warranty covering aluminum-framed entrances and storefronts that fail in materials or workmanship within 5-years from date of Substantial Completion. Failures include, but are not limited to structural failures including excessive deflection, excessive leakage or air infiltration, faulty operation, and deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Interior Aluminum Storefronts: Mimo by Miuraflex.

2.02 MATERIALS

A. Aluminum Members: 6063-T5 alloy and temper to match existing.

B. Fasteners: Series 300 nonmagnetic stainless steel.

1. Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws countersunk flush that match the finish of member or hardware item being fastened.

D. Brackets and Reinforcements: Aluminum or nonmagnetic stainless steel. Provide non-staining, non-ferrous shims for installation and alignment as required.

F. Framing System Gaskets: Acoustic compression type, replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

G. Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.03 COMPONENTS

A. Pivot Type Entrance Doors: Frameless glass pivot door per schedule.

1. Glazing: Clear tempered.

2. Design: Frameless

3. Each door leaf shall be equipped with an adjusting mechanism located in the top rail near the lock stile, which provides for minor clearance adjustments after installation.

B. Windows:

1. Window Type: Clear tempered glass.

C. Miscellaneous Brake Shapes: Provide headers, closures, anchors and supports as indicated and required. Fabricate from minimum 0.090-inch aluminum unless otherwise indicated.

2.04 FABRICATION

A. General: Fabricate aluminum-framed entrances and storefronts to designs, sizes and thicknesses indicated, and to comply with specified standards. Sizes and profile requirements are indicated.

B. Fabricate components that, when assembled, have the following characteristics:

1. Profiles are sharp, straight, and free of defects or deformations.

2. Physical and thermal isolation of glazing from framing members. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

3. Provisions for field replacement of glazing from interior or exterior as standard for installed storefront framing.

4. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site. Disassemble components only where necessary for shipment and installation.

1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete these operations for hardware prior to application of finishes.

2. Do not drill and tap for surface-mounted hardware items until time of installation at Project site.

D. Welding: Comply with AWS recommendations. Grind exposed welds smooth to remove weld spatter and welding oxides. Restore mechanical finish.

1. Welding behind finished surfaces shall be performed to minimize distortion and discoloration on the finished surface.

E. Reinforcing: Install reinforcing as required for hardware, performance requirements, sag resistance and rigidity.

F. Dissimilar Metals: Separate dissimilar metals with bituminous paint, suitable sealant, elastomeric tape, or gasket between the surfaces. Do not use coatings containing lead.

G. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.

H. Conceal fasteners wherever possible.

I. Provide miscellaneous aluminum brake metal closures and flashings as indicated, finished to match aluminum-framed entrances and storefronts.

2.05 FINISHES

A. Exposed surfaces shall be free of scratches and other blemishes.

B. Exposed surfaces shall be finished with a Class I integral or electrolytically-deposited color anodized finish conforming to AA-M12C22A42/A44, color to match existing from within standard industry colors and color density range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions with installer present, for compliance and requirements for installation tolerances and other conditions affecting performance of the work.

B. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation.

B. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Install components in proper alignment and relation to established lines. Provide proper support and anchor securely in place

C. Installation Tolerances:

1. Variation from Plane: Do not exceed 1/8-inch in 12-feet of length or 1/4-inch in any total length.

2. Offset from Alignment: The maximum offset from true alignment between two identical members abutting end-to-end in line shall not exceed 1/16-inch.

3. Diagonal Measurements: The maximum difference in diagonal measurements shall not exceed 1/8-inch.

4. Offset at Corners: The maximum out-of-plane offset of framing at corners shall not exceed 1/32-inch.

D. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

1. Paint dissimilar metals where drainage from them passes over aluminum.

2. Paint aluminum surfaces in contact with mortar or concrete with alkali-resistant coating.

3. Paint wood and similar absorptive material in contact with aluminum and exposed to the elements or otherwise subjected to wetting, with 2-coats of aluminum house paint. Seal joints between the materials with sealant.

E. Drill and tap frames and doors and apply surface-mounted hardware in compliance with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

F. Set sill members and other members in bed of sealant, or use joint fillers or gaskets to provide weathertight construction. Comply with requirements of Section 07 92 00.

H. Set miscellaneous brake shapes flush with hairline joints to adjacent storefront systems.

3.03 ADJUSTING

A. Adjust operating hardware to function properly for smooth operation without binding, and to prevent tight fit at contact points and gasketing.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform specified testing.

B. Air Infiltration Test: Conduct tests in accordance with ASTM E783. Allowable air infiltration shall not exceed 1.5 times the amount specified in the performance requirements.

C. Repair or remove work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.04 CLEANING

A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. Clean glass surfaces after installation, complying with the requirements specified in Section 08 80 00. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

3.05 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

B. Provide adhered, non-marring strippable plastic protection over all framing members at time of installation, prior to glazing.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for interior glass and glazing.

B. Related Sections:

1. Flush wood doors are specified in Section 08 14 16.

2. Aluminum Framed Entrances and Storefronts in Section 08 41 13.

1.02 DEFINITIONS

A. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating resulting from seal failure, and any other visual evidence of seal failure or performance.

B. Deterioration of laminated glass is defined as the development of manufacturing defects including edge separation or delamination which materially obstructs vision through glass.

C. Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic coating due to normal conditions of use.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure attributable to defective manufacture, fabrication or installation, including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

B. Normal thermal movement is defined as that resulting from an ambient temperature range of 120-deg. F. and from a consequent temperature range within glass and glass framing members of 180-deg. F.

C. Provide heat strengthened glass lites where recommended by glass manufacturer as determined by glass stress analysis calculations based on glass unit sizes indicated and shading patterns occurring on the glass. Furnish copies of the glass stress analysis calculations and show the location of glass units required to be heat strengthened on the shop drawings.

1.04 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.

C. Samples: 12-inch square samples of each type of glass indicated and specified except for clear single pane units, and 12-inch long samples of each type of sealant or gasket exposed to view.

D. Shop Drawings: Show location of exterior glass units required to be heat strengthened based on glass stress analysis calculations.

E. Calculations: Furnish calculations showing glass stresses based on glass lites and shading patterns. Calculations shall be prepared by the glass manufacturer and shall be signed by a registered professional engineer licensed in the State of California.

F. Glazing Schedule: Indicate glass types and thicknesses for each size opening and location. Use same

designation indicated on the Drawings.

G. Qualification data for installer.

H. Preconstruction adhesion and compatibility test report.

I. Warranty.

1.05 QUALITY ASSURANCE

A. Glazing Standards: Comply with recommendations of the following manufacturer and associations except where more stringent requirements are specified:

1. Glass Association of North America (GANA) "Glazing Manual" and "Sealant Manual".

2. American Architectural Manufacturers Association (AAMA): AAMA TIR-A7 "Sloped Glazing Guidelines" and "Glass Design for Sloped Glazing".

3. Sealed Insulating Glass Manufacturers Association (SIGMA): TM-3000 "Vertical Glazing Guidelines" and TB-3001 "Sloped Glazing Guidelines".

B. Safety Glass: Where safety glass is indicated or required, provide products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials. Permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested in accordance with ASTM E2074, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Fire-Resistive Glazing Products for Window Assemblies: Products identical to those tested in accordance with ASTM E2010, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

E. Insulating Glass Certification Program: Provide insulating glass units permanently marked with appropriate Insulating Glass Certification Council (IGCC) certification label.

F. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that required for this Project, with a record of successful in-service performance.

G. Field-Constructed Mock-Up: Prior to glazing, erect mockups for each glass product indicated to verify selections made and to demonstrate aesthetic effects and quality of materials and workmanship. Incorporate typical glass lite size, framing system, and glazing methods.

1. Construct mockup on site in location and of size indicated or as directed by the Architect.

2. Obtain Architect's acceptance of mockups before start of glazing work.

3. Retain and maintain mockups during construction in undisturbed condition as a standard for judging completed glazing.

H. Preconstruction Compatibility and Adhesion Testing: Furnish samples of glass, gaskets, glazing accessories, and glass framing members proposed for use in contact with, or proximity of, glazing sealants, to sealant manufacturer for compatibility and adhesion testing in accordance with sealant manufacturer's standard testing methods.

1. Furnish not less than 9 pieces of each type and finish of glass framing and of each type, class, kind, condition, and form of glass for adhesion testing and one sample of substrates (gaskets, setting blocks, and spacers) for compatibility testing.

2. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the work.

3. Testing is not required when glazing sealant manufacturer can submit required preparation data that is acceptable to the Architect and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

4. For materials failing tests, furnish sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

I. Source Limitations: Obtain float glass, laminated glass and insulating glass from a single source from a single manufacturer for each glass type. Obtain glazing accessories from a single source from a single manufacturer for each product and installation method.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Protect glazing materials during delivery, storage, and handling; comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture, temperature changes, direct exposure to sun and from other causes.

1.07 PROJECT CONDITIONS

A. Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when glazing channel substrates are wet.

B. Install glazing sealants at ambient and substrate temperatures above 40-deg. F.

1.08 WARRANTY

A. Laminated Glass: Furnish written warranty signed by glass manufacturer, agreeing to furnish replacements for those laminated glass units which develop manufacturing defects as defined, within 5-years from date of Substantial Completion.

B. Insulating Glass: Furnish written warranty signed by glass manufacturer, agreeing to furnish replacements for those insulating glass units developing manufacturing defects as defined, within 10-years from date of Substantial Completion.

C. Coated Glass: Furnish written warranty signed by glass manufacturer agreeing to furnish replacements for those coated glass units developing manufacturing defects as defined, within 10-years from date of Substantial Completion.

D. Mirror Glass: Furnish written warranty agreeing to furnish replacement mirrors for those units developing silver spoilage within 15-years from date of Substantial Completion.

E. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 GLASS PRODUCTS

A. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as required to comply with Project conditions.

B. Manufacture heat-treated glass by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed.

2.02 GLASS TYPES

A. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 1/4-inch thick.

B. Clear Tempered Float Glass: ASTM C1048, Condition A, Type I, Class 1, Quality q3, Kind FT; 1/4-inch thick.

C. Clear Laminated Glass: Two sheets of 1/4-inch thick clear float glass laminated together with a 0.030-inch thick clear plastic interlayer; nominal 1/2-inch thick.

D. Clear Fire-Rated (Non-Wire) Safety Glass: O'Keeffe's Inc./SAFTI FIRST Fire Rated Glazing Solutions "SuperLite C/S and C/SP" or approved equal fire protective and safety rated ceramic glazing tested in accordance with NFPA 80, NFPA 252, NFPA 257, UL 9, UL 10B, UL 10C, UBC-7-2 and UBC-7-4.

1. Thickness: 3/16-inch.

2. Fire Rating: 20-180 minutes, as scheduled.

3. Appearance: Slight amber with some surface irregularity.

4. Impact Safety Resistance: CPSC 16 CRR 1201 Cat. I & II.

5. Each piece of fire-rated glazing material shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory, fire rating period and safety glazing standards.

6. Glazing materials installed in Hazardous Locations, subject to human impact, shall be certified and permanently labeled as meeting applicable requirements referenced in NFPA 80:

a. CPSC 16 CFR 1201, Cat. I & II.

2.03 ELASTOMERIC GLAZING SEALANTS

A. General: Comply with recommendations of sealant and glass manufacturer's for selection of glazing sealants with performance characteristics suitable for applications indicated and conditions at time of installation.

1. Compatibility: Select sealants with proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants which have performance characteristics suitable for applications indicated and conditions at time of installation.

3. Colors: Color of exposed sealant as selected by Architect from manufacturer's standards.

B. Silicone Glazing Sealant: One-part elastomeric silicone sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Uses NT, G, A and 0 as applicable; Dow Corning 999, General Electric "SCS 1200", Rhone-Poulenc, Inc. "Rhodorsil 3B", Tremco "Proglaze" or approved equal.

C. Glazing Sealant for Fire-Rated Glass: Metacaulk 990, DAP 1012 or approved equal, listed and approved by UL, Warnock Hersey or other approved testing agency.

2.04 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100-percent, non-staining and non-migrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged in rolls with a release paper backing, complying with AAMA 800.

B. Expanded Cellular Glazing Tape: Closed-cell, polyvinyl chloride foam tape, factory coated with adhesive on both surfaces, packaged on rolls with release liner protecting adhesive, and complying with AAMA 800 for product 810.5.

C. Glazing Tape for Fire-Rated Glass: EPDM or other approved flame resistant gasket material approved by testing agency.

2.05 GLAZING GASKETS

A. Dense Elastomeric Compression Seal Gaskets: Molded or extruded neoprene, EPDM, or silicone gaskets of profile and hardness required to maintain watertight seal; complying with ASTM C864, D.S. Brown Co., Maloney, Tremco or approved equal.

B. Soft Compression Gaskets: Extruded or molded closed cell, integral-skinned neoprene, EPDM, or silicone of profile and hardness required to maintain watertight seal; complying with ASTM C509, Type II, black; D.S. Brown Co., Maloney, Tremco or approved equal.

2.06 MISCELLANEOUS GLAZING MATERIALS

A. Compatibility: Provide materials with a proven record of compatibility with surfaces contacted in installation.

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

C. Setting Blocks: Silicone blocks, 80 to 90 Shore A durometer hardness.

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

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement.

F. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonextruding, nonoutgassing, strips of closed-cell plastic foam of density, site, and shape to control sealant depth and otherwise contribute to produce optimum sealant performance.

G. Mirror Mastic: Palmer "Mirro-Mastic" or approved equal for securing glass mirrors.

2.07 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

B. Clean cut or flat grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect work for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; presence and functioning of weep system on framing having weeps; existence of minimum required face or edge clearances; and for effective sealing of joinery. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members to receive glass. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are to be used.

3.03 GLAZING, GENERAL

A. Comply with printed recommendations of glass, sealants, gaskets, and other glazing materials manufacturers.

B. Coordinate with framing system manufacturers for proper glazing channel dimensions to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with acceptable tolerances.

C. Protect glass from edge damage during handling and installation.

1. Use a rolling block in rotating glass units to prevent damage to corners. Use suction cups to shift glass units within openings; do not raise of drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening.

2. Remove and dispose of glass units with edge damage or other imperfections of a kind that would weaken glass when installed and impair performance and appearance.

D. Apply primers to joint surfaces where required for sealant adhesion.

E. Install setting blocks of proper size in sill rabbet, located to comply with referenced glazing standard. Set blocks in thin course of sealant.

F. Provide spacers inside and out, of size and spacing to preserve required face clearances for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking to comply with requirements of referenced glazing standard except where otherwise required by glass unit manufacturer.

H. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Square cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each lite is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward center of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket

manufacturer.

C. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets.

3.07 PROTECTION AND CLEANING

A. Protect glass from breakage. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances. Remove immediately by methods recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction for build-up of dirt, scum, alkali deposits or staining. Remove as recommended by glass manufacturer.

D. Remove and replace glass which is broken, chipped, cracked, abraded or damaged during construction, including natural causes, accidents and vandalism.

E. Wash glass on both faces not more than 4-days prior to date scheduled for inspection for Substantial Completion. Use methods recommended by glass manufacturers.

END OF SECTION

SECTION 08 91 00

LOUVERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:

1. Extruded aluminum drainable blade louvers.

1.02 SYSTEM DESCRIPTION

A. Structural Performance: Engineer, fabricate and install exterior metal louvers to withstand the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and support, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE 7.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects. Temperature change (range) shall be 120-deg. F. ambient; 180-deg. F. material surfaces.

1.03 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Shop Drawings: Furnish shop drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades, unit dimensions related to wall openings and construction, free areas for each size, and profiles of frames at jambs, heads, and sills.

C. Samples: 6-inch square samples of each required finish. Prepare samples on metal of same gauge and alloy to be used in work.

D. Warranty.

1.04 QUALITY ASSURANCE

A. Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) recommendations for fabrication, construction details and installation procedures, except as otherwise indicated.

B. Welding Standards: Comply with applicable provisions of D1.2 "Structural Welding Code - Aluminum" and D1.3 "Structural Welding Code - Sheet Steel".

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify size, location and placement of louver units prior to fabrication, and show on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.06 WARRANTY

A. Furnish warranty covering louver finish against cracking, checking, blistering, peeling, flaking, chipping, chalking and fading, as defined, for 20-years following date of Substantial Completion.

B. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005 with temper as required for forming.

B. Aluminum Extrusions: ASTM B221, Alloy 6063-T5 or T52.

C. Fastenings: Same material as items fastened or 300 series stainless steel. Do not use metals that are corrosive or incompatible with joined materials. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors and Inserts: Non-ferrous metal or hot-dip galvanized for exterior installations and as required for corrosion resistance. Use steel or lead expansion bolt devices for drilled-in-place anchors.

E. Bituminous Paint: Cold-applied asphalt mastic.

2.02 FABRICATION

A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal thicknesses indicated or as required.

B. Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as required for shipping and handling limitations. Mark units for reassembly and coordinated installation.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide sill extensions and loose sills made of same material as louvers where required for drainage to exterior and to prevent water penetrating to interior.

G. Join frame members to one another and to stationary louver blades by welding, except where otherwise indicated or where field bolted connections between frame members are required. Maintain equal blade spacing, including separation between blades and frames at head and sill.

2.03 FINISHES

A. Class I Color Anodic Finish: AA-M12C22A42/A44, integrally colored or electrolytically deposited color coating containing 0.7-mil or thicker, complying with AAMA 606.1 or AAMA 608.1.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Locate and place louvers plumb, level and in proper alignment with adjacent work.

B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes with no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make required alterations, and refinish entire unit, or provide new units.

F. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulations, and install as work progresses to make installations weather-tight.

3.02 ADJUSTING AND PROTECTION

A. Protect louvers and vents from damage during construction, including use of temporary protective coverings where required.

B. Restore louvers and vents damaged during installation and construction so that no evidence remains of corrective work. If restoration results are unsuccessful as judged by the Architect, remove damaged units and replace with new units.

3.03 CLEANING

A. Periodically clean exposed surfaces of louvers and vents that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing light-gauge non-load bearing wall framing systems, including metal studs, wall furring, and backing plates.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Load-bearing metal studs are specified in Section 05 40 00.

3. Acoustical joint sealants are specified in Section 07 92 19.

4. Metal suspension systems are specified in Section 09 22 26.23.

5. Acoustical ceiling suspension assemblies are specified in Section 09 53 23.

6. Gypsum board shaft wall assemblies are specified in Section 09 21 16.23.

7. Gypsum board is specified in Section 09 29 00.

8. Acoustic insulation is specified in Section 09 81 00.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. General: Where stud gauge and spacing is not indicated, engineer non-structural metal framing to comply with the following requirements.

B. Stud Systems: Select steel studs in accordance with manufacturer's standard load tables and the following deflection criteria, based on stud depth and spacing indicated and partition height required:

1. Partitions to Receive Gypsum Board: L/240.

2. Partitions to Receive Tile Backer Board: L/360.

3. Partitions to Receive Plaster: L/360.

4. Framed Ceilings: L/360.

B. Structural supports and blocking for light fixtures and miscellaneous wall- or ceiling-mounted items shall be designed and engineered by Contractor.

1.03 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's specifications and installation instructions for each type of metal support system, including provisions for fixture and equipment anchorage.

C. Shop Drawings: Show provision for fixture and equipment anchorage to stud systems different from typical systems or details indicated.

1.04 QUALITY ASSURANCE

A. Tolerances: Provide metal studs and furring installations that are plumb, true, straight, and rigid.

B. Welder's Qualifications: AWS D1.1 and 1.3 as applicable.

C. Fire-Test-Response Characteristics: Provide components that comply with rating requirements specified for fire-

rated assemblies under UL 2079 for non-load bearing wall systems.

1. Deflection Clips and Firestop Track: Connections and/or top runner provided in fire-resistance-rated assemblies shall be certified by UL 2079 for cyclic movement requirements.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver products in the original unopened packages, containers, or bundles with manufacturer's label intact and legible.

C. Remove products delivered in broken, damaged, rusted or unlabeled condition from the Project site immediately.

D. Protect products from rusting and other sources of damage.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Angeles Metal Products, Clark/Dietrich., Consolidated Systems, Inc., Dale/Incor Industries, Delta Metal Products,, Knorr Steel Framing Systems, The Steel Network Inc., Unimast, Inc., Western Metal or approved equal.

2.02 MATERIALS

A. Metal Studs:

1. Material: Mill-certified galvanized steel conforming to ASTM A653, G40 coating, minimum yield strength 33,000-psi.

2. Construction: Formed C-channel section conforming to ASTM C645.

3. Size and Thickness: As indicated on drawings.

3. Stud Thickness: As required for specified deflection criteria, based on stud depth and spacing indicated and partition height required. If stud spacing is not indicated, space studs at 16-inches on center.

B. Runner Tracks:

1. Material: Mill-certified galvanized steel conforming to ASTM A653, G40 coating, minimum yield strength 33,000-psi.

2. Construction: Formed channel section conforming to ASTM C645.

3. Size: Minimum 1-inch flange width; web depth matching studs.

4. Thickness: Same as studs.

C. Vertical Deflection Connection: The Steel Network Inc. "VertiClip" or "VertiTrack", FireTrak Corp "Shadowline", Metal-Lite "Slotted Slip Track" or approved equal conforming to the following material properties and performance criteria:

1. Code Criteria: Meet required head of wall connection criteria as required by CBC and as indicated in UL2079 for cyclic wall movement.

2. Material Composition: ASTM A653, SS grade 50, class 1, 50-ksi minimum yield strength, 65-ksi minimum tensile strength, G-60 hot dipped galvanized coating.

3. Material Thickness: 0.036-inch.

4. Clips shall be designed for positive attachment to structure and stud web using step-bushing technology to provide frictionless vertical movement.

5. Provide clips with attached bushing and screw of the series, size, and configuration as recommended by manufacturer.

6. Top track devices pre-assembled to top track assembly in standard 12-foot lengths, with clips installed at spacing to coincide with stud spacing indicated may be used at Contractor's option.

7. Friction-fit deep-leg track assemblies and tracks relying on steel flexure to perform are unacceptable.

D. Metal Channels: Mill-certified galvanized steel conforming to ASTM C653, G40 coating, minimum yield strength 33,000-psi.

1. Framing, Furring, and Stiffening:

Size, Inches	Pounds per 1,000 Lineal Feet
3/4 cold rolled	300
1-1/2 cold rolled	475
2 cold rolled	590

2. Furring Channels: Minimum 20-gauge galvanized steel with knurled faces; hat-shaped or Z-section as required.

E. Tie Wire: No. 16-gauge, galvanized, single-strand annealed steel or No. 18-gauge, galvanized, double-strand annealed steel.

F. Screws: ASTM C1002, Type S, pan head sheet metal screws, minimum 1/2-inch length.

G. Runner Track Fasteners: Powder-actuated tempered-steel pins with corrosive resistant plating or coating, 9/64-inch diameter, minimum 1-1/8-inch penetration. The use of powder-actuated anchors is not permitted in concrete where the actual concrete strength exceeds the concrete strength at which the anchor has been tested to provide the required capacity unless the anchor capacity is verified by field testing.

H. Backing Plates: Provide backing plates as indicated.

I. Compression or Isolation Strips: Fiberglass, 1/2-inch nominal thickness, width equal to width of tracks or studs where used; density such that material will compress to one-half or less of loose thickness.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

A. Verify that conditions are satisfactory for the installation of metal support systems. Do not commence the installation until unsatisfactory conditions have been corrected.

B. Coordinate installation of metal support systems with the installers of other related work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install non-load-bearing steel framing members in accordance with ASTM C754, and as specified.

B. Cutting:

1. General: Cut framing components squarely or on angle as required to fit tightly with proper bearing against abutting members.

2. Cutting Studs: If stud web is cut more than 50-percent, or stud flanges are cut, restore stud to original strength by wire-tying, or welding on steel reinforcement.

C. When studs extend to the underside of structural slabs, secure at top with a slip connection to accommodate slab deflection.

3.03 NON-LOAD-BEARING VERTICAL METAL FRAMING

A. Runner Tracks: Align at floor and ceiling with partition layouts. Secure to structure with specified fasteners

located 2-inches from each end and spaced not to exceed 24-inches on center.

1. Coordinate installation of continuous isolation strips or acoustical sealant at acoustical partitions with installation of top and bottom runner tracks.

2. Where partition comes to underside of profile metal deck, create an acoustic seal to fill the profile. Use either metal plate or fiberglass and acoustic sealant, as indicated.

3. Notch runner tracks as required for curved partitions.

4. Where studs extend to structure above, provide vertical deflection accommodating devices where each stud connects to structural members above.

B. Installation of Metal Studs:

1. Install studs spaced 16-inches on center unless otherwise indicated. Screw-fasten framing connections using a minimum of 2 screws for each connection.

2. At partition corners and intersections, provide a minimum of 3 studs.

3. Splice studs where required, by nesting with a minimum lap of 8-inches; fasten laps with 2 screws through each flange.

4. Unless otherwise indicated, frame door openings with double 16-gauge vertical studs securely attached to each jamb of door frame.

   a. At head, install runner track; cut flanges at ends, bend web 90-degrees and screw attach to jamb studs.

   b. Install jack studs over door opening, spaced same as full-height studs.

   c. Where control joints extend upward from door jambs, install a jack stud spaced 1/2-inch from each jamb stud. Space next full-height stud not more than 6-inches from each jamb stud.

   d. Attach jamb studs to metal door frames with metal clips, each with 2 screws into jamb stud.

   e. Attach jamb studs to wood door frames with pairs of wood screws, spaced 24-inches on center.

5. Frame openings other than door openings in the same manner as for doors, and install framing below sills of openings to match framing required above door heads.

6. Frame both sides of expansion and control joints with a separate stud; do not bridge the joint with framing components.

7. Install continuous horizontal stiffeners in partitions where recommended by stud manufacturer for partition height, stud gauge, stud spacing, number of layers of gypsum board used, and anticipated stud deflection.

8. Stiffen openings with horizontal channels. Provide one channel continuous across head of openings extending to third stud beyond on each side. Provide one channel at each frame anchor extending to third stud beyond. Wire-tie or weld horizontal channels to each stud.

C. Chase-Wall Framing:

1. Align two parallel rows of floor and ceiling runners according to partition layout.

2. Position steel studs vertically in runners with flanges in same direction, with studs on opposite sides of chase directly across from each other. Anchor to runners in accordance with manufacturer's instructions.

3. Cross brace chase studs with 12-inch wide gypsum wallboard gussets or minimum 2-1/2-inch steel studs. Attach web-to-web with screws. If chase wall studs are not opposite, brace with horizontal runners and braces.

D. Wall Furring, Direct Attachment:

1. Attach hat-shaped metal furring channels either vertically or horizontally. For furring positioned horizontally, attach a furring member not more than 4-inches from both the floor and ceiling. Secure with fasteners placed on alternate channel flanges, spaced on 16-inch centers.

2. Attach Z-shaped metal channels vertically, spaced 16-inches on center unless otherwise indicated, with fasteners spaced 24-inches on center.

3.04 BACKING PLATES

A. Install as indicated and specified for support of wall-hung cabinets, toilet partitions and accessories, and other items to be mounted on vertical surfaces.

B. Welding shall comply with AWS D1.3.

C. Paint welds with a rust-inhibitive paint.

3.05 HORIZONTAL FRAMED SURFACES

A. Joist frame with studs of size, gauge and spacing indicated or as determined from manufacturer's standard tables based on specified deflection criteria.

B. Provide runner channels to receive studs at ceiling and walls of same gauge as studs. Secure with mechanical fasteners at 24-inches on center maximum.

C. Secure studs to channels with screws.

D. Provide furring channels in resilient sound isolation clips as indicated.

3.06 SOUND CONTROL WORK

A. Specified requirements apply to framing for interior partitions indicated as sound partitions.

B. Isolate top and bottom runners from direct contact with structure by installing over either:

1. Continuous compression or isolation strips as specified, or

2. Two continuous 1/4-inch beads of acoustical sealant specified in Section 07 92 19 applied at quarter points of track width.

C. Studs at terminal ends of partitions abutting intersecting walls or partitions, and studs that would otherwise contact intermediate structural columns shall be similarly installed over strips or sealant.

3.07 INSTALLATION TOLERANCES

A. Variation from Plumb: Maximum 1/8-inch in 10-feet, non-cumulative.

B. Variation from Level: Maximum 1/8-inch in 10-feet, non-cumulative.

C. Variation from True Plane: Maximum 1/8-inch in 10-feet, non-cumulative.

D. Variation from True Position: Maximum 1/4-inch, non-cumulative.

E. Variation of Member from Plane: Maximum 1/8-inch, non-cumulative.

3.08 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION

SECTION 09 22 26.23

METAL SUSPENSION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:

1. Metal ceiling suspension systems, including suspension system for gypsum wallboard ceilings and plaster ceilings and soffits.

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B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Miscellaneous rough carpentry is specified in Section 06 10 53.

3. Non-structural metal framing is specified in Section 09 22 16.

4. Metal lath is specified in Section 09 22 36.23.

5. Portland cement stucco is specified in Section 09 24 23.

6. Gypsum board is specified in Section 09 29 00.

7. Acoustical ceiling suspension assemblies are specified in Section 09 53 23.

8. Acoustic insulation is specified in Section 09 81 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's specifications and installation instructions for each type of suspension system, including provisions for fixture and equipment anchorage.

1. Include ICC-ES test reports showing proposed hanger and bracing wire fasteners are capable of supporting specified loads.

1.03 QUALITY ASSURANCE

A. Ceiling-support system shall limit deflection of finished ceilings to less than L/360.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver products in the original unopened packages, containers, or bundles with manufacturer's label intact and legible.

C. Remove products delivered in broken, damaged, rusted, or unlabeled condition from Project site immediately.

D. Protect products from rusting and other sources of damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Metal Channels: ASTM C645, galvanized in accordance with ASTM A653, G60 coating designation.

1. Framing, Furring, and Stiffening:

Size, Inches	Pounds per 1,000 Lineal Feet
3/4 cold rolled	300
1-1/2 cold rolled	475
2 cold rolled	590

2. Furring Channels: Minimum 20-gauge galvanized steel with knurled faces; hat-shaped or Z-section as required.

B. Hanger Wire: Galvanized, soft, mild annealed steel; 8-gauge, unless otherwise indicated, complying with ASTM A641.

C. Diagonal Bracing Wire: Galvanized, soft, mild annealed steel; 12-gauge, unless otherwise indicated, complying with ASTM A641.

D. Tie Wire: No. 16-gauge, galvanized, single-strand annealed steel or No. 18-gauge, galvanized, double-strand annealed steel.

E. Screws:

1. General: ASTM C1002, corrosion resistant, for attachment to metal framing 25-gauge and lighter; ASTM C954 for attachment to metal framing 20-gauge and heavier.

2. Thread and head designs and lengths as recommended by manufacturer for uses and materials involved.

F. Hanger and Bracing Wire Fasteners: The use of powder-actuated anchors is not permitted in concrete where the actual concrete strength exceeds the concrete strength at which the anchor has been tested to provide the required capacity unless the anchor capacity is verified by field testing.

1. Hanger Wires: Connection device capable of carrying not less than 100-pounds.

2. Bracing Wires: Connection device capable of carrying not less than 200-pounds or the actual design load, whichever is greater, with a safety factor of 2 without yielding.

G. Furring Channel Clips: Fabricated from galvanized wire, for attaching furring channels to cold-rolled channels.

H. Compression Stiffeners: 20-gauge channel studs, 1-1/2-inches.

I. Acoustic Isolation Hangers: Mason 30N spring hangers or approved equal.

PART 3 - EXECUTION

3.01 SUSPENDED CEILING SUSPENSION FRAMING

A. Space 8-gauge hanger wires 48-inches on center along carrying channels and within 6-inches of ends of carrying channels.

B. At acoustic suspension framing system, install acoustic isolation hangers in accordance with manufacturer's instructions.

C. Install 1-1/2-inch cold rolled carrying channels 48-inches on center and within 6-inches of walls. At splices, interlock flanges, overlap ends 12-inches, and wire-tie with double loops of No. 16-gauge wire.

D. Install 3/4-inch cold rolled channels or 7/8-inch furring channels, as indicated, at right angles to carrying channels, spaced 24-inches on center and within 6-inches of walls. Provide one-inch clearance between furring channels and abutting walls and partitions. Attach to carrying channels by saddle-tying around carrying channels with one strand of No. 16 or two strands of No. 18-gauge tie wire. At splices, nest furring channels with a minimum 8-inch overlap and wire-tie each end with double loops of No. 16-gauge wire.

E. Install 4-way 45-degree diagonal bracing wires at 12'-0" x 12'-0" within 6-inches of walls. Diagonal bracing wires shall be located at the intersection of main runner and cross-furring member. Provide connection between diagonal wires and main runner so as to prevent slipping for a 200-pound approximate seismic load.

F. Install hanger and bracing wire anchors so the direction of the wire aligns as closely as possible with the direction of the forces acting on the wire.

G. Separate ceiling hanging and bracing wires at least 6-inches from unbraced ducts, pipes, and conduit.

H. Fasten wires with not less than 4 tight turns. Make all tight turns within a distance of 1-1/2-inches.

I. Install uplift stiffener for each 144-square feet of ceiling, consisting of a vertical metal stud occurring at the junction of the carrier and furring channel. Wire tie to carrier or screw to channel and secure to overhead structure.

J. At control joints, provide discontinuous lap in main runners occurring over joints. Do not bridge joints with cross furring where joints run perpendicular to furring. Where joints run parallel to furring, provide furring to support each side of joint.

K. Provide recesses and openings where indicated for lighting fixtures, registers, access panels, and other items to be installed in ceilings; provide additional furring channels where required by opening.

L. Recessed or drop-in light fixtures shall be supported directly by main runners or by supplemental framing which is supported by main runners.

M. Surface mounted fixtures shall be attached to a main runner with a positive clamping device made of material with a minimum of 14-gauge. Rotational spring catches are not acceptable.

N. At acoustic suspension framing system, install fire-retardant plywood as specified in Section 06 10 53 and acoustic batt insulation as specified in Section 09 81 00.

3.02 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD & SOUND RATED GYPSUM BOARD

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:

1. Gypsum board and associated accessories.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Gypsum sheathing is specified in Section 06 16 43.

3. Firestopping is specified in Section 07 84 00.

4. Acoustical joint sealants are specified in Section 07 92 19.

5. Non-structural metal framing is specified in Section 09 22 16.

6. Metal suspension systems are specified in Section 09 22 26.23.

7. Cementitious backing boards are specified in Section 09 28 13.

8. Acoustic insulation is specified in Section 09 81 00.

9. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's specifications and installation instructions for each type of gypsum board and accessory required.

C. Shop Drawings: Furnish layout drawing showing proposed location of control joints.

D. Samples: 12-inch long samples of each type of trim.

1.03 QUALITY ASSURANCE

A. Provide products manufactured in North America only.

B. Gypsum board work shall comply with ASTM C840 and California Building Code (CBC) Section 2508 unless otherwise indicated or specified.

C. Installation and finishing of gypsum board shall comply with GA-216. Installation of fire-rated gypsum board shall comply with their listing descriptions indicated on the Drawings.

D. Fire-Resistance Ratings: Where gypsum board systems with fire-resistance ratings are indicated, provide materials and installations identical with those of applicable assemblies tested in accordance with ASTM E119 by fire testing laboratories acceptable to authorities having jurisdiction.

1. Provide fire-resistance-rated assemblies identical to those indicated by reference to GA File No's. in GA-600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in listing of other testing and agencies acceptable to authorities having jurisdiction.

E. Allowable Tolerances:

1. Gypsum board surfaces shall have no measurable variation in any 2-foot direction and a maximum variation of 1/8-inch in 10-feet when a straightedge is laid on the surface in any direction. Specified tolerances apply to both plumbness of walls and levelness of ceilings.

2. Shim work as required to comply with specified tolerances.

3. Do not exceed 1/16-inch offset between planes of abutting sheets at edges or ends.

F. Mock-up: Install mock-up using approved gypsum products, including fasteners and related accessories, in accordance with manufacturer's instructions and recommendations.

1. Size: 100-square feet.

2. Prepare mock-up for each level of exposed gypsum board finish.

3. Approved mock-up may remain as part of the work.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Delivery:

1. Deliver materials to the Project site in original package containers or bundles with manufacturer's labels intact and legible.

2. Deliver fire-rated materials bearing the testing agency's label and classification identification.

C. Storage:

1. Store gypsum board in accordance with GA-238 and manufacturer's recommendations.

2. Store materials indoors in a dry area, under cover, and stacked flat off the floor.

3. Stack gypsum boards so that long lengths are not over short lengths.

D. Handle gypsum board to avoid damaging face and edges of sheets.

E. Protect metal corner beads and trim from being bent or damaged.

1.05 PROJECT CONDITIONS

A. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer's recommendations.

B. Minimum Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40-deg. F. For adhesive attachment and finishing of gypsum board, maintain not less than 50-deg. F. for 48-hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

D. Provide for continuous ventilation during installation, using as close to 100-percent outside air as possible.

E. Protect workers and HVAC system from gypsum dust.

F. Remove and replace all gypsum board products that are exposed to water and display mold and mildew. Removal shall occur as soon as possible after exposure to water.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. United States Gypsum, CertainTeed Gypsum, Inc., Georgia Pacific, National Gypsum Company or approved equal.

B. Gypsum board at sound-rated construction: 5/8-inch thick Type 'X' having a minimum mass of 2.2 PSF.

2.02 GYPSUM BOARD

A. Regular Gypsum Board: United States Gypsum “SHEETROCK SW”, CertainTeed Gypsum, Inc. “ProRoc” or approved equal with tapered rounded edge to minimize ridging or beading and other joint imperfections.

1. ASTM C1396, regular type.

2. Thickness: 5/8-inch unless otherwise indicated.

B. Fire-Rated Gypsum Board: United States Gypsum “SHEETROCK SW Type X”, CertainTeed Gypsum, Inc. “ProRoc Type X” or approved equal with tapered rounded edge to minimize ridging or beading and other joint imperfections.

1. ASTM C1396, Type X fire-resistant type.

2. Thickness: 5/8-inch.

3. Provide United States Gypsum “Firecode C”, CertainTeed Gypsum, Inc. “ProRoc Type C” or approved equal solid set, fire-resistive core panels where required for fire-rated assemblies in Gypsum Association Fire Resistance Design Manual.

C. Regular Mold- and Moisture-Resistant Gypsum Board: United States Gypsum “SHEETROCK Mold Tough”, CertainTeed Gypsum, Inc. “ProRoc Moisture and Mold Resistant with M2TECH” or approved equal noncombustible, moisture- and mold-resistant gypsum core encased in moisture- and mold-resistant, 100-percent recycled face and back papers. Panels shall have a tapered long edge.

1. ASTM C1396, regular type.

2. Thickness: 5/8-inch unless otherwise indicated.

3. Mold Resistance: Panel score of 10 when tested in accordance with ASTM D3273.

D. Fire Rated Mold- and Moisture-Resistant Gypsum Board: United States Gypsum “SHEETROCK Mold Tough Type X”, CertainTeed Gypsum, Inc. “ProRoc Moisture and Mold Resistant with M2TECH Type X” or approved equal noncombustible, moisture- and mold-resistant gypsum core encased in moisture- and mold-resistant, 100-percent recycled face and back papers. Panels shall have a tapered long edge.

1. ASTM C1396, Type X fire-resistant type.

2. Thickness: 5/8-inch.

3. Mold Resistance: Panel Score of 10 when tested in accordance with ASTM D3273.

4. Provide United States Gypsum “SHEETROCK Mold Tough Firecode C” or approved equal solid set, fire-resistive core panels where required for fire-rated assemblies in Gypsum Association Fire Resistance Design Manual.

E. Fire-Rated Abuse-Resistant Gypsum Board: United States Gypsum “SHEETROCK Mold Tough AR Type X”, CertainTeed Gypsum, Inc. “ProRoc Abuse Resistant Type X” or approved equal abuse-resistant gypsum panels with a noncombustible, moisture- and mold-resistant core encased in moisture- and mold-resistant, 100-percent recycled face and back papers. The face paper shall be folded around the long edges to reinforce and protect the core. Panels shall have tapered long edges.

1. ASTM C1396, Type X fire-resistant type.

2. Thickness: 5/8-inch.

3. Provide United States Gypsum "SHEETROCK Mold Tough AR Firecode C", CertainTeed Gypsum, Inc. "ProRoc Abuse Resistant Type C" or approved equal solid set, fire-resistive core panels where required for fire-rated assemblies in Gypsum Association Fire Resistance Design Manual.

2.03 GYPSUM BOARD ACCESSORIES

A. Screws: ASTM C954 or ASTM C1002.

1. Use Type S screws for gypsum board attachment to light steel framing.

2. Use Type S-12 screws for gypsum board attachment to 20-gauge and heavier steel framing.

3. Use Type G screws for gypsum board attachment to gypsum board.

4. Use Type W screws for gypsum board attachment to wood framing.

B. Metal Trim: Galvanized steel, 26-gauge minimum; profiles and dimensions indicated.

1. Corner Beads: United States Gypsum "Dur-A-Bead" or approved equal.

2. Casing Beads: United States Gypsum or approved equal.

3. Control Joints: Roll-formed zinc with perforated flanges, 1-3/4-inch wide with 1/4-inch wide center channel with removable tape strip over channel.

C. Reveals: Extruded aluminum alloy 6063-T5, profiles indicated, finish as selected by the Architect.

D. Joint-Treatment Materials: ASTM C475.

1. Drying-type (ready mixed): United States Gypsum "SHEETROCK" all-purpose joint compound or approved equal.

2. Setting-type (chemically hardening): United States Gypsum "SHEETROCK" setting-type joint compound or approved equal.

3. Low-Dust Emission Type: United States Gypsum "SHEETROCK" Plus 3 ready-mixed lightweight all purpose joint compound with dust control or approved equal.

E. Reinforcing Joint Tape: ASTM C475, 2-inch nominal width.

F. Acoustical Sheet Sealant Pad: Harry A. Lowry & Associates, 3M or approved equal.

G. Resilient Channels: Unimast "RC Deluxe", Cemco "RC-1", Dale/Incor RFC-1", Clark/Dietrich "RCSD" or approved equal.

H. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

I. Primer/Surfacer: United States Gypsum "SHEETROCK" Tuff-Hide" primer-surfacer or approved equal.

J. Access doors at sound-rated construction equivalent to fire-rated access door.

1. Door panel: Double wall insulated.

2. 1-1/2-inch-thick minimum mineral wool insulation.

3. Continuous piano hinge.

4. Acceptable products: Babcock-Davis B-ITK-SFB (888-412-3726), or Williams Bros. Corp. WB-FR Premium (775-827-4585).

K. Sound Isolation Clips: Acceptable products: Kinetics Isomax (Acousthetics: 415-753-1301), Pliteq Genie Clip (The Finish Line: 650-233-1360), or PAC International RSIC-1 (1-866-774-2100)

L. At sound-rated construction provide fire-rated access doors. Seal door flanges with Pemko S-88 smoke seal at perimeter. Seal entire assembly to gypsum board with acoustical sealant.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that conditions are satisfactory for the installation of gypsum board and accessories.

1. Check framing for accurate spacing, alignment, plumbness, and levelness. Verify that both new and existing framing members will result in gypsum board surfaces complying with specified tolerances.

2. Verify spacing of installed framing does not exceed maximum allowable for thickness of board to be used.

3. Verify door frames are set for thickness of board to be used.

4. Repair protrusions of framing, twisted framing members, or unaligned members before installation of gypsum board commences.

B. Do not commence the installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF SOUND ISOLATION CLIPS

A. General – Install work in accordance with the manufacturer's approved product installation procedures.

C. Load on each sound isolation clip shall be 50 lbs. maximum with 22-gage furring channels.

D. Furring channels supported by clips shall be one-inch clear of all intersecting surfaces.

3.02 APPLICATION OF GYPSUM BOARD

A. Apply materials in conformance with ASTM C840, the manufacturer's instructions, and as indicated.

B. When gypsum board is to be applied to both walls and ceilings, apply to ceilings first.

C. Resilient Framing:

1. Partitions: Apply resilient channels at right angles to framing. Position bottom channel with resilient channel attachment flange either up or down; position other channels with resilient channel attachment flanges down. Attach with 1-1/4-inch screws. Locate resilient channels 2-inches from floor, within 6-inches of ceiling, and not more than 24-inches on center.

2. Ceilings: Apply resilient channels at right angles to framing. Attach with 1-1/4-inch screws driven through channel attachment flange. For fire-rated, double-layer assembly, apply channels over base layer and attach with 1-7/8-inch screws driven through channel flange and base layer into joist. Fasten channels to joists at each intersection.

D. For partitions, apply full height sheets with long dimension parallel to framing members with abutting edges over

supports. Where ceiling heights exceed 10'-0" and where required by fire resistive ratings, apply sheets with long dimension perpendicular to framing members. For ceilings, apply sheets with long dimension either perpendicular or parallel to framing members to result in fewest joints. For fire-rated assemblies, apply gypsum board in accordance with CBC Tables 720.1(2) and 720.1(3) as applicable.

E. Use sheets of maximum lengths to minimize end joints.

F. Neatly fit and stagger end joints.

G. Locate joints on different studs at opposite sides of partition.

H. Cut and fit neatly around outlets and switches. Back-to-back wall penetrations shall be at least two stud spaces apart for acoustic isolation.

I. Double-Layer Application:

1. Apply base layer with long dimension perpendicular to and centered on framing; apply face layer parallel to framing. Apply base layer parallel to framing where required by fire-resistive ratings.

2. Stagger sheets of each layer so that joints of each layer are 16-inches apart.

J. Isolation of Gypsum Board from Other Construction:

1. Provide perimeter relief where gypsum board abuts structural decks, ceilings, vertical structural elements, or window sections.

2. Finish gypsum board edge with corner bead.

3. Seal space between casing bead and structure with continuous sealant bead.

4. Seal around electrical boxes and conduit and pipe penetrations.

5. Seal at base of gypsum board sheets.

K. Acoustic Control Requirements for Sound Walls:

1. Leave a 1/8- to 1/4-inch space between gypsum board and adjacent construction to provide a space for acoustical sealant.

2. Seal airtight with acoustical sealant material specified in Section 07 92 19.

3. Seal penetrations through walls, or cuts in one face of walls, with a full bead of sealant at perimeter; this includes provisions for electrical outlet and switch boxes, pipes, ducts, and similar items.

4. Seal electrical boxes at the back with specified sheet sealant pad. Where wires enter the boxes, seal the openings airtight around the wires and knockout openings.

5. Install mild steel sleeves where required, fiberglass packing between sleeve or framing, service and cover plates. Seal on both sides to render airtight.

6. Tolerance: 1/8-inch between wall boarding and sleeve, 3/8- to 5/8-inch between sleeve and service.

L. Installation of Fasteners:

1. Do not locate fasteners less than 3/8-inch from edges or ends of sheets. Do not locate fasteners less than one-inch from edges or ends in horizontal applications.

2. Fire-Rated Partitions: Install fasteners in accordance with the more restrictive of either CBC Table 720.1(2) or the Underwriters' Laboratories assemblies as denoted on partition schedule.

3. Non-Fire-Rated Partitions: Install fasteners in accordance with GA-216 and ASTM C840.

4. Fire-Rated Ceilings: Install fasteners in accordance with CBC Table 720.1(3).

5. Non-Fire-Rated Ceilings: Install fasteners spaced not more than 12-inches on center.

6. Install screws using powered screw guns with adjustable screw-depth control head. Drive shank perpendicular to gypsum board surface. Do not hammer screws.

7. Set fastener heads slightly below surface of gypsum board, but do not break or strip paper face around fastener.

8. Stagger fasteners opposite each other on adjacent ends and edges.

9. Omit fasteners at edges where metal edge trim will be installed.

M. Installation of Accessories:

1. Install corner trim at vertical and horizontal external corners and angles, and edge trim at junctions of gypsum board and other materials and at exposed edges.

2. Control Joints:

a. Ceilings: Maximum area for ceilings with perimeter relief shall be 2,500-sq. ft.; maximum area for ceilings without perimeter relief shall be 900-sq. ft. Do not exceed 50-feet between control joints in ceilings with perimeter relief; 30-feet between control joints in ceilings without perimeter relief.

b. Walls and Partitions: Maximum spacing between control joints shall not exceed 30-feet.

c. Control joint locations shall occur only where indicated on reviewed layout drawings.

N. Double layer application:

1. Joints: Stagger 24-inches between layers.

2. Sound-rated construction: Tape face layer.

O. Sound-rated edge condition: Stagger (i.e., ship-lap) gypsum board layers at vertical intersections. Provide a 1/4-inch nominal gap around the gypsum board face layer at floor and ceiling intersections. Fill the 1/4-inch gap with acoustical sealant to form an airtight seal.

P. Installing gypsum board on resilient clips: Attach gypsum board to furring channel only. Gypsum board screws shall not contact wall framing.

3.03 TAPING AND FINISHING

A. Finish Levels: Provide levels of gypsum board finish for locations as follows, in accordance with Gypsum Association GA 214 “Recommended Specification: Levels of Gypsum Board Finish”.

1. Level 0: In areas of temporary construction, no taping or accessories are required.

2. Level 1: Ceiling plenum areas and concealed areas. Provide higher level of finish as required to comply with fire-resistance ratings and acoustical ratings.

3. Level 2: Not used.

4. Level 3: Gypsum board surfaces, where textured finishes or wall coverings will be used.

5. Level 4: Gypsum board surfaces, except where another finish level is specified.

6. Level 5: Gypsum board surfaces to receive eggshell, semigloss, or gloss paints, and surfaces subject to severe or critical natural or artificial side lighting.

B. Interior Gypsum Board Finishing:

1. Taping (Level 1):

a. Use taping or all purpose compound.

b. Butter taping compound into inside corners and joints.

c. Center tape over joints and press down into fresh compound.

d. Remove excess compound. Tape joints of gypsum board above suspended ceilings.

2. First Coat (Level 2):

a. Use taping or all-purpose drying-type compound or setting-type joint compound.

b. Immediately after bedding tape, apply skim coat of compound over body of tape and allow to dry completely in accordance with manufacturer's instructions.

c. Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.

3. Second Coat (Level 3):

a. Use all purpose or topping drying type joint compound.

b. After first coat treatments is dried, apply second coat of compound over tape and trim, feathering compound 2-inches beyond edge of first coat.

4. Third Coat (Level 4):

a. Use all purpose or topping drying type joint compound.

b. After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 2-inches beyond edge of second coat.

c. Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, ready for application of finish.

5. Skim Coat (Level 5):

a. Apply skim coat of all-purpose drying-type compound over exposed surfaces of gypsum board.

b. After skim coat has dried, touch-up and sand to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.

C. Cut edges and openings around pipes and fixtures shall be caulked flush with sanitary sealant as specified in Section 07 92 00.

D. In the completed installation, gypsum board shall have plumb and straight surfaces with no waves or buckles. Joints, fastener heads, and trim flanges shall be invisible after finishing. Surfaces shall be uniformly smooth and ready for painting or other decoration.

E. Primer/Surfacer: Complete gypsum board surface to Level 4 before applying primer-surfacer. Machine-apply with airless sprayer in conformance with manufacturer's instructions to a wet film thickness of 15- to 20-mils. Allow to dry overnight before painting.

3.04 PENETRATIONS (through Sound-Rated Construction)

A. Cut-outs are to be regular and not fracture core or tear covering of gypsum board and meet the following requirements.

B. Minimize penetrations of insulated wall and ceiling constructions. Penetrate only where necessary and fully seal airtight at the perimeter using acoustical sealant.

C. Where ducts and piping greater than 3-inches diameter penetrate insulated wall or ceiling construction, provide a clearance of 1-inch ± 1/4-inch at the perimeter of the penetration.

D. Where conduit piping 3-inches diameter and less (including mechanical, hydraulic, plumbing, etc.) pass through insulated wall or ceiling construction, provide a clearance of 1/4-inch ± 1/8-inch between the conduit or piping and the structure, unless otherwise shown.

E. After the ductwork, conduit or piping has been installed, repair the gypsum board perimeter clearance to the specified tolerance as required. Where the clearance exceeds 3/4-inch, provide a sheet metal sleeve within the partition packed with safing insulation batts and caulk both sides airtight with an acoustical sealant. Where the perimeter clearance exceeds 3/8-inch, use a flexible backing rod to caulk against.

F. Where penetration clearances are 3/8-inch or less, caulk airtight with acoustical sealant at gypsum board.

G. All gypsum board penetrations (including those resulting from wiring, cables, and electrical junction boxes) are to be sealed airtight with acoustical sealant.

H. The back and sides of junction boxes in sound-rated construction must be sealed airtight with sheet caulking. Caulk perimeter face at gypsum board with acoustical sealant.

I. Recessed panel boards, equipment, boxes, etc. with penetration area greater than 25 sq. in. at sound-rated partitions are to be fully enclosed and sealed with 5/8-inch thick gypsum board or 2 psf sheet lead.

J. Seal multiple conduit penetrations airtight with expanding fire foam sealant.

K. Seal other sound-rated conditions with spray-applied (40 pcf) cementitious sealant equal to Monokote Z-146.

3.05 PROTECTION OF FINISHED WORK

A. Maintain temperature and humidity conditions as required to protect the installation.

B. Protect completed gypsum board from damage or deterioration until final acceptance of the work.

3.06 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Separate clean waste gypsum products from contaminants for recycling. Do not include wood, plastic, metal, asphalt impregnated gypsum board or any gypsum board coated with glass fiber vinyl, decorative paper, paint or other finish. Place in designated area and protect from moisture and contamination. Protect scraps and pulverized material from moisture and contamination.

C. Clean, unpainted waste gypsum products may be recycled by:

1. Returning to gypsum board manufacturer in lieu of landfill.

2. Hauling to alternative use manufacturer in lieu of landfill.

D. Separate metal waste and place in designated areas for recycling or reuse.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for the materials and installation of acoustical ceiling panels.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Metal acoustical ceiling suspension assemblies are specified in Section 09 53 23.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's descriptive and technical data and illustrations. Include MSDS data sheets.

C. Material Samples: Duplicate sets of full-size panels for each type and size of acoustical unit required.

D. Warranty.

1.03 EXTRA MATERIALS

A. In addition to acoustical panels for completing installations required, furnish additional units, in typical field sizes, for each type of unit used in the work.

B. Furnish quantities equal to not less than 3-percent of total installed area of each type of unit or greater to result in full carton lots for each type, except not less than one full carton for any one type of unit.

C. Supply extra units from production lots or color runs the same as for units used in the work, and supply in cartons as factory packaged and labeled. Also identify cartons with Project name and type of ceiling panel.

D. Deliver materials to project premises just prior to substantial completion, and store at location as directed.

1.04 WARRANTY

A. Warrant acoustical ceiling panels to be free from visible sag and against mold, mildew and bacteria for a period of 30-years from Date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 ACOUSTICAL PANEL TYPE ACT-1

A. Approved Manufacturers: Armstrong “School Zone Fine Fissured” Item No**.** 1713 or approved equal.

B. Material: Mineral fiber, wet-formed.

C. Typical Field Size: Nominal 24- x 24-inches, 3/4-inch thick.

D. Edges: Square.

E. NRC: .70.

F. CAC: 35.

G. Flame Spread Classification: Class A.

H. Light-Reflectance: 0.85.

I. Finish and Color: Factory-applied, washable, vinyl-latex paint in manufacturer's standard off-white color.

J. Acoustical panels shall have antimicrobial treatment on front face.

K. Recycled Content:

1. Post-consumer Recycled Content: 0- to 2-percent.

2. Pre-consumer Recycled Content: 40- to 53-percent.

L. VOC Formaldehyde: No added.

2.02 ACOUSTICAL PANEL TYPE ACT-2

A. Approved Manufacturers: Armstrong “Ultima” Item No. 1912.

B. Material: Mineral fiber, wet-formed.

C. Typical Field Size: 24-inches x 24-inches x 3/4-inch thick.

D. Edges: Beveled Tegular.

E. NRC: 0.70.

F. CAC: 35.

G. Flame Spread Classification, ASTM E84: 0-25.

H. Light-Reflectance: 0.90.

I. Finish and Color: Factory-applied, washable, vinyl-latex paint in manufacturer's standard off-white color.

J. Recycled Content:

1. Post-consumer Recycled Content: 2-percent.

2. Pre-consumer Recycled Content: 68-percent.

K. VOC Formaldehyde: No added.

A. Approved Manufacturers: Armstrong “School Zone Fine Fissured” Item No. 1713 or approved equal.

B. Material: Mineral fiber, wet-formed.

C. Typical Field Size: Nominal 24- x 28-inches, 3/4-inch thick.

D. Edges: Square.

E. NRC: .70.

F. CAC: 35.

G. Flame Spread Classification: Class A.

H. Light-Reflectance: 0.85.

I. Finish and Color: Factory-applied, washable, vinyl-latex paint in manufacturer's standard off-white color.

J. Acoustical panels shall have antimicrobial treatment on front face.

K. Recycled Content:

1. Post-consumer Recycled Content: 0- to 2-percent.

2. Pre-consumer Recycled Content: 40- to 53-percent.

L. VOC Formaldehyde: No added.

PART 3 - EXECUTION

3.01 AMBIENT CONDITIONS

A. Building shall have been entirely enclosed and heated not less than 10-days before start of suspended-ceiling work.

B. Before installation, acoustical units shall have been stored within the spaces where they are to be used for not less than 3-days, and with cartons opened and stripped sufficiently to permit units to stabilize to ambient conditions.

C. Remove and replace all acoustical panel ceiling products that are exposed to water and display mold and mildew. Removal shall occur as soon as possible after exposure to water.

3.02 INSTALLATION

A. Install acoustical panels in suspended grid system in accordance with manufacturer's instructions for discontinuous floating cloud.

B. Field-cut edges of tegular edge acoustical panels shall be routed to match the edge profile of uncut panels so that panels lay in grid system flush with adjacent un-cut panels and edges of cut panels match the appearance of uncut panels or provide KAM-12 edge.

C. Touch-up edges to match factory cut panels.

3.03 COMPLETION

A. Acoustical panels shall rest uniformly on their supporting members and shall be flat and free from twist and warp.

B. Exposed surfaces of acoustical units shall be clean and free from scratches, dents, tool marks, stains, discoloration, fingerprints, and other defects and damage.

3.04 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Separate waste and place in designated areas in the following categories for recycling:

1. ½ panels and larger, set aside for reuse by Owner, non-profit organizations such as Habitat for Humanity, etc.

2. Place scrap panels in designated areas for recycling or reuse.

3. Separate cardboard waste and place in designated areas for recycling.

END OF SECTION

SECTION 09 61 43

WATER VAPOR EMISSION AND HUMIDITY TESTING AND CONTROL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this Section includes the following:

1. Retaining and paying for an independent Testing Laboratory to perform moisture vapor emission, in-concrete relative humidity and alkalinity-pH testing on new concrete slabs to receive carpet, resilient flooring, bamboo flooring, and other applied flooring materials.

2. Applying a vapor emission control system treatment when testing reveals vapor emission or alkalinity levels exceeding specified maximums at no cost to the Owner. Include mechanical preparation, control system, primers and cement topcoat products as specified.

B. Related Sections:

1. Resilient sheet flooring is specified in Section 09 65 16.

2. Resilient tile flooring is specified in Section 09 65 19.

3. Tile carpeting is specified in Section 09 68 13.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Furnish product data on treatment materials proposed for use, ASTM laboratory test reports, and application instructions.

C. Test Diagram: Prepare a moisture, humidity and pH report of each test area. Include name of company performing the test; types of testing instruments used; floor plan of building with each test location identified; starting date, time, and beginning weight; estimate of building temperature; stopping date, time, and ending weight; pH levels; and computed pounds of emission, including equations.

D. Warranty.

1.03 QUALITY ASSURANCE

A. Installer: Manufacturer's trained personnel or factory-trained authorized installer. Installer shall have a minimum of 5-years documented experience in the installation of concrete vapor emission control systems.

B. Manufacturer: Minimum 5-years experience producing two-component water-based control systems.

1.04 PROJECT CONDITIONS

A. Maintain temperature range of 55-deg. F. and 85-deg. F. for 72-hours prior to, during, and after application of vapor control sealer.

1.05 WARRANTY

A. Warranty failure of finish flooring system due to concrete water vapor emission to the installed system for a period of 15-years from date of Substantial Completion. Include replacement of finish flooring material, and re-application of adhesive, vapor emission control system. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Vapor Emission Control Sealer: Synthetics Intl. “Synthetic 30”, Ardex Engineered Cements “Ardex-MC” or approved equal.

B. Humidity Testing Equipment: American Moisture Test “AMT Moisture / Relative Humidity Meter” or approved equal.

C. Alkalinity Testing Equipment: American Moisture Test “AMT Concrete Digital Alkalinity-pH Meter” or approved equal.

2.02 MATERIALS

A. Vapor Control Sealer: Two-component waterborne polymer designed to penetrate concrete slabs and seal cracks, joints, and slab imperfections. The resins allow the polymers to saturate porous concrete and embed a dense, high compressive film strength within the concrete to restrict water vapor emission, alkalinity migration and 100-percent relative humidity transfer.

1. Water Vapor Transmission Rate, ASTM E96:

a. Grains/sq. ft./hour: 0.6.

b. Pounds/1000-sq. ft./24-hrs: 2.0.

2. Water Vapor Permeance, ASTM E96: 1.4-perm (inch-pound).

3. Pull-off Concrete Adhesion, ASTM D4541: Minimum 225-psi.

4. Alkali Resistance – 30-day Exposure, ASTM D1308: 14pH.

5. In-Concrete Relative Humidity, ASTM F2170: Tolerant to 100-percent RH.

6. Alkalinity pH, ASTM F710: Resistant to 14pH.

7. Water Vapor Emission, ASTM F1869: Control up to 15-lbs.

8. EPA Method 24 Volatile Organic Compound (VOC): 62 g/liter.

9. California Department of Health Services Section 01350 Emission Testing Results: Standard Classroom & Office Space: Pass. No formaldehyde or other CREL VOCs detected.

B. Vapor Emission Testing Equipment: Manufacturer’s standard.

C. Humidity Testing Equipment: Manufacturer’s standard sleeves, RH probes, sleeve caps and humidity meter.

D. Alkalinity Testing Equipment: Meter shall be capable of wide range 1- 15 pH measurements per ASTM F170.

PART 3 - EXECUTION

3.01 VAPOR EMISSION TESTING

A. Perform pre-installation testing of the concrete slab by a calcium chloride test prior to the application of specified water vapor emission control system treatment. Testing shall be performed by a qualified testing personnel and Testing Laboratory.

B. Perform three tests for the first 1,000-sq. ft. of flooring and one additional test for each additional 1,000-sq. ft. of flooring. Conduct around the perimeters of the room, center of room and where moisture may be evident.

1. Moisture: Perform ASTM F1869 anhydrous calcium chloride testing on clean concrete slabs; free of curing, sealing, adhesive residue, water and surface contaminates in a area 20-inches by 20-inches 24-hours before test kits are installed.

2. Alkalinity: Perform ASTM F710 alkalinity testing during retrieval of moisture tests, directly inside dome area by placing several drops of manufacture provided solution to concrete surface. Wait 60-seconds

and apply digital LCD pH meter. Record results to the nearest hundredth on final test report.

3. Temperature, Humidity and Surface Thermometer: Document temperature, humidity and surface temperature at installation and retrieval of moisture kits on final testing report. Note dew point temperature for control barrier installations.

C. Tests shall determine the change in weight of moisture-absorbing anhydrous calcium chloride and the results shall represent the amount of moisture transmitting out of the concrete slab area. The value shall be expressed in pounds and shall be equivalent to the weight of the water that is emitted from a 1,000-sq. ft. concrete slab area in a 24-hour period of time.

D. Unless more restrictive emission levels are required by finish flooring manufacturer, if calcium chloride testing reveals water vapor emission levels greater than 3-pounds per 1,000-sq. ft. for resilient flooring, bamboo flooring, and 5-pounds per 1,000-sq. ft. for adhesively-applied carpet, apply sealer in accordance with manufacturer's instructions. Alkalinity readings shall not exceed 9.0pH for adhesive applied flooring.

3.02 HUMIDITY TESTING

A. Where applied floor coverings have published relative humidity tolerances, perform humidity testing of concrete slabs in accordance with ASTM F2170.

B. Test results shall be expressed in percent and whether or not the concrete is acceptable to receive floor coverings, coatings, toppings or vapor control sealers.

C. Concrete floors to be tested shall be at service temperature and interior room space above the floor slab shall be at service temperature and service humidity for at least 48-hours.

D. Test at a rate of three tests for areas up to 1,000-sq. ft. and one more test for each additional 1,000-sq. ft. of floor area.

E. Select test sites away from windows, protected from direct sunlight and 4-feet from exterior walls.

F. Drill a 2-inch deep hole using an SDS hammer drill with a 5/8-inch bit. Blow the hole free of debris using compressed air and a vacuum. Insert the pre-measured sleeve in the hole and secure. Insert the RH probe, install sleeve cap and allow to remain for 72-hours. Allow holes to reach equilibrium for 72-hours. Remove the sleeve cap and connect the meter cable to the probe. Allow the probe to re-acclimate for 30-minutes.

G. Mark all test numbers and locations directly on the concrete surface. When readings are required at a later date, apply the sleeve cap and return to test as required.

H. Unless more restrictive humidity levels are required by finish flooring manufacturer, do not install flooring when humidity levels are greater than 75-percent RH.

3.03 ALKALINITY TESTING

A. Perform alkalinity testing using pH testing meter in accordance with manufacturer’s instructions.

B. Perform testing at a rate of three tests for the first 1,000-square feet of flooring and one additional test for each 1,000-square feet of flooring thereafter.

C. Alkalinity readings above 9.0 pH are considered excessive and require remediation prior to installing flooring materials.

3.04 APPLICATION OF VAPOR EMISSION CONTROL SYSTEM

A. Surface Preparation:

1. Concrete shall cure for 48-hours and be structurally sound, clean, free of dust, grease, oil, existing coatings, paint marks, carbonated layers and other potential contaminants.

2. Concrete shall be heavily profiled in accordance with the International Concrete Surface Repair Institute to a Concrete Surface Profile (CSP) #4.

3. Profile edges, joints and cracks clean with a diamond crack chasing blade, removing fill.

4. Acid etching, sanding discs or grinding surfaces are not acceptable.

5. Vacuum entire surface with an industrial unit. Do not use clean sweep agents.

B. Mixing: Mix in accordance with manufacturer's instructions.

C. Application:

1. Pre-dampen concrete with clean water using an airless sprayer.

2. Allow surface to dry for 20-minutes and broom areas that puddle.

3. Pour product on concrete and scrub into surface with a nylon broom.

4. While wearing spike shoes re-apply product after 40-minutes.

5. Spread evenly over entire surface following rates recommended by manufacturer based on slab vapor emission levels. Apply multiple coats if required by slab vapor emission levels.

D. Crack and Joint Treatment: Cracks and joints less than 1/8-inch wide may be sealed during application. Re-seal cracks that remain exposed after application with additional product for greater crack bridging in accordance with manufacturer's instructions.

E. Cement Patching/Leveling:

1. Allow material to cure for a minimum of 12- to 24-hours before using a cement product to smooth uneven floor transitions. Cement shall be a minimum thickness of 1/8-inch to allow proper adhesive transfer.

2. Apply a non-porous primer to secure cement products.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes the following:

1. Resilient wall base.

2. Resilient flooring accessories.

3. Resilient carpet accessories.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Resilient tile flooring is specified in Section 09 65 19.

3. Tile carpeting is specified in Section 09 68 13.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Submit for each type of product specified.

C. Samples: Samples for verification purposes in manufacturer's standard sizes, but not less than 12-inches long, of each different color and pattern of product specified.

1.03 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45-watts per sq. cm or more per ASTM E648.

2. Smoke Density: Less than 450 per ASTM E662.

B. All materials shall comply with the requirements of Air Quality Management District (AQMD) Rule 1168 governing the emission of Volatile Organic Compounds.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

C. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50- and 90-deg. F.

D. Move products into spaces where they will be installed at least 48-hours in advance of installation.

1.05 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70-deg. F. in spaces to receive products specified in this Section for at least 48-hours prior to installation, during installation, and for not less than 48-hours after installation. After this period, maintain a temperature of not less than 55-deg. F.

B. Do not install products until they are at the same temperature as that of the space where they are to be installed.

C. Close spaces to traffic during installation of products specified in this Section.

D. Provide for continuous ventilation during installation using as close to 100-percent outside air as possible.

1.06 SEQUENCING AND SCHEDULING

A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

1.07 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

1 Furnish not less than 10-linear feet for each 500-linear feet or fraction thereof of each different type and color of resilient wall base installed.

PART 2 - PRODUCTS

2.01 RESILIENT WALL BASE

A. Rubber Wall Base: Johnsonite, Burke, Flexco, VPI, Roppe or equal complying with ASTM F1861, Type TS or TP.

1. Style: Cove with top-set toe for use with resilient flooring, straight with no toe for use with carpet.

2. Height: 4-inches.

3. Lengths: Coils in lengths standard with manufacturer but not less than 100-feet.

4. Exterior Corners: Pre-molded.

5. Interior Corners: Pre-molded.

6. Ends: Pre-molded.

7. Color: To be selected by the Architect.

2.02 RUBBER ACCESSORIES

A. Provide rubber cap for cove vinyl sheet flooring, carpet edge for glue down applications, reducer strip for resilient flooring, and tile/carpet transition strips.

B. Profile and Dimensions: As indicated.

C. Color: As selected by the Architect from manufacturer's standards.

2.03 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

C. Adhesives: Provide type and brands of solvent free water-resistant adhesive as recommended by manufacturer of resilient wall base and accessories for conditions of installation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.

B. Use trowelable leveling and patching compounds per manufacturers directions to fill cracks, holes, and

depressions in substrates.

C. Broom or vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

3.02 INSTALLATION

A. Install products specified in this Section using methods indicated according to manufacturer's installation directions.

B. Apply resilient wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

1. Install inside and exterior corners before installing straight pieces.

C. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.

3.03 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing installation:

1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.

2. Damp-mop resilient accessories to remove black marks and soil.

B. Clean products specified in this Section not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products using method recommended by manufacturer.

3.04 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Close and seal tightly all partly used adhesive containers and store protected in well ventilated fire-safe area at moderate temperatures.

C. Place used adhesive tubes and containers in areas designated for hazardous materials.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing tile carpeting.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Water vapor emission and humidity testing and control systems are specified in Section 09 61 43.

3. Resilient base and accessories are specified in Section 09 65 13.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Include the following:

1. Reports documenting the results of tests by a NVLAP approved laboratory for electrostatic propensity and flooring radiant panel test.

2. Catalog data and product physical characteristics.

3. Manufacturer's printed installation instructions, surface preparation, seaming techniques, recommended adhesives and other installation accessories.

4. Statement verifying environmental requirements.

5. Maintenance instructions including recommended cleaning equipment and materials, spot removal information, and cleaning methods.

C. Samples:

1. For verification purposes, two full size tiles of each color and pattern selected.

2. 12-inch long sample of carpet accessories.

D. Layout Drawings: Show layout of each area to be covered for approval of pattern, and any pertinent installation details.

E. Maintenance Materials:

1. Furnish the Owner with a minimum of 5-percent of each different material and color used in this Project from same dye lot or production run for compatibility with the installed materials.

2. Furnish materials in securely wrapped packages or factory sealed packing with the manufacturer's standard labels and the material and color designation used in these specifications.

3. Deliver material to the Owner's on site designated storage place, unloaded and positioned in place per Owner's instructions.

4. Furnish a signed receipt indicating materials and quantities upon delivery.

F. Warranty.

1.03 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Carpet tiles shall be approved by applicable jurisdictions.

B. Fire Hazard Classification: Class I floor finish. Minimum critical flux limit of 0.45-watts/square centimeter when tested in accordance with NFPA 253.

C. Static electricity generation of installed carpet shall not exceed 3.5 KV at 70-deg. F and 20-percent R.H. for life of carpet tile.

D. Installer's Qualifications: Installer shall be approved by carpet tile manufacturer, and shall have regularly been providing installations of the types required for no less than five years.

E. Visually perceptible deviations in color at sides and end seams shall not be acceptable.

F. Indoor Air Quality: Carpet tile shall meet or exceed the minimum standards contained in the Carpet and Rug Industry (CRI) Institute consumer information label.

G. Comply with CRI – Carpet and Rug Institute Indoor Air Quality Green Label Testing Program.

1. All carpet tile products shall comply with the VOC limit established by the Carpet and Rug Institute (CRI) Green Label Indoor Air Quality Test Program.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver and store packaged materials in original containers labels intact until time for use, with seals unbroken and store rolls in a flat position. Protect from damage, dirt, stains and moisture.

C. Do not store carpet tile near products that can off gas harmful substances.

1.05 PROJECT CONDITIONS

A. Sequencing Schedule: Do not install carpet tiles until building is entirely closed in, wet work and painting is completed, and heating system is in operation.

B. Use adhesives in strict compliance with manufacturer's recommendations, and ventilate area with maximum outside air for a minimum of 48-hours after installation.

C. Test substrates to ensure that no dusting will occur through installed carpet tile. Apply sealer on porous concrete surfaces where required to prevent dusting.

1.06 INDOOR AIR QUALITY

A. Pre-ventilate carpet tile in well ventilated, uninhabitated space for a few days prior to installation.

B. Provide maximum ventilation during installation.

C. Isolate area of installation from remainder of building.

D. Clean new carpet tile thoroughly with a high-efficiency particulate air (HEPA) filtration vacuum.

1.07 WARRANTY

A. Warrant the carpet tile to be free of defects for a period of 5-years from date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 CARPET TILE

A. General: Carpet substitutions shall match all characteristics of the specified carpet.

B. Carpet Tile: Manufacturer, pattern and color as indicated on the Drawings.

2.02 ACCESSORIES

A. Carpet Adhesive: Acrylic emulsion, solvent-free, meeting or exceeding CRI “Green Label” requirements, as recommended by carpet tile manufacturer.

B. Crack Filler: Latex base type.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive carpet tiles and verify that surfaces are suitable for installation.

B. Test concrete floors for moisture with suitable moisture meter. Moisture shall not exceed adhesive manufacturer's recommendations, as specified in Section 09 61 43.

C. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Subfloor:

1. Prior to installation, repair minor floor irregularities and thoroughly clean floor, leaving no dirt or grit.

2. Fill cracks exceeding 1/16-inch in width with crack filler and sand smooth.

3. Confirm compatibility of adhesive with sealers or curing agents on concrete floors.

3.03 INSTALLATION

A. Apply carpet tiles in strict accordance with manufacturer's instructions.

B. Install carpet tiles in accordance with the recommendations contained in the Carpet and Rug Institute (CRI) “CRI Carpet Installation Standard 2011”

C. Cement carpet tiles directly to floor. Remove excess cement with approved solvent.

D. Cut evenly along walls, cut and fit evenly around projections, corners, pipes, electrical outlets, floor air or heating elements, and trim strips.

E. Securely fasten carpet edging strips to floor wherever carpet tiles meet different floor material and no threshold or other divider is noted.

F. Extend carpet tile materials under all open-bottomed and raised-bottom obstructions, and under removable flanges of obstructions. Extend carpet tiles into closets and alcoves of rooms indicated to receive carpeting, unless another material is specifically identified to be used in that space. Carpet tile shall be installed under all movable furniture and equipment.

G. Finish installation shall be free from visual defects.

H. The Owner may review carpet tile scraps and retain any he chooses. Remove remainder of scraps from site.

I. Leave carpet base and walls clean and free from stains, blemishes and other foreign material. Remove loose threads and vacuum clean.

J. Installation shall not receive furniture or heavy traffic for 48-hours after installation.

3.04 CLEAN UP

A. After completion of the carpet tile installation, remove all waste and excess materials, tools and equipment. The complete installation shall be thoroughly vacuumed, using an upright, commercial grade, beater type cleaner, and left in a clean condition. Provide all necessary temporary protection required.

3.05 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. All scraps of unused material shall be reclaimed and recycled by the carpet tile manufacturer. Include a detailed confirmation of the material received by the manufacturer and documentation that these materials haven recycled into new flooring materials. No incineration of reclaimed materials is acceptable.

END OF SECTION

SECTION 09 81 00

ACOUSTIC INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing acoustic insulation.

B. Related Sections:

1. Construction waste management is specified in Section 01 74 19.

2. Miscellaneous rough carpentry is specified in Section 06 10 53.

3. Thermal insulation is specified in Section 07 21 00.

4. Roof board insulation is specified in Section 07 22 16.

5. Firestopping insulation is specified in Section 07 84 00.

6. Acoustical joint sealants are specified in Section 07 92 19.

1.02 SUBMITTALS

A. General: As specified in Section 01 33 00.

B. Product Data: Manufacturer's specifications for each type of insulation required.

1.03 QUALITY ASSURANCE

A. Fire Ratings: Comply with fire-resistance and flammability ratings specified.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Protect insulation from physical damage and from becoming wet or soiled. Comply with manufacturer's recommendations for handling, storage and protection during installation.

1.05 INDOOR AIR QUALITY

A. Protect ducts and HVAC system from loose insulation particulates.

B. Provide temporary ventilation of building areas where building insulation is being installed.

PART 2 - PRODUCTS

2.01 ACOUSTIC INSULATION

A. Formaldehyde-Free Unfaced Glass Fiber Blanket/Batt Acoustical Insulation: Acoustical insulation produced by combining glass fibers with formaldehyde-free thermosetting resins to comply with ASTM C665, Type I.

1. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50 when tested in accordance with ASTM E84.

2. Approved Manufacturers: Johns Manville "Formaldehyde-Free Sound Control Fiber Glass Batts", Owens Corning "QuietZone Acoustic Batts" or approved equal.

3. Thickness: 3-inches unless otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's instructions for installation conditions.

B. Do not install insulation until building is sufficiently enclosed or protected against absorption of moisture by the insulation, and do not install insulation unless supporting framing and construction is in a thoroughly dry condition.

C. Install snugly between framing members with ends snugly fitted between units and against adjacent construction.

D. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.

E. Where door and window frames occur in framing, cut additional strips of insulation and hand-pack as required to fill voids in and around such frames.

3.02 PROTECTION

A. Protect installed insulation from harmful exposures and from physical damage.

3.03 WASTE MANAGEMENT

A. General: Comply with Section 01 74 19.

B. Plan and coordinate the insulation work to minimize the generation of offcuts and waste. Remove insulation scraps to the maximum extent feasible.

C. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for painting and finishing of interior and exterior exposed items and surfaces.

1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatments specified in other Sections.

2. Work includes painting exposed pipes and ducts, hangers, exposed steel and iron, and primed metal surfaces of Mechanical and Electrical equipment, and general sheet metal work, except as otherwise indicated or specified.

3. Work includes painting hardware specified as primed (USP or 600).

4. Work includes sanding shop-primed surfaces and applying specified primer and finish coats.

5. "Paint" means coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

B. Surfaces Not to Be Painted:

1. Pre-finished items, including but not limited to acoustic materials, casework, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.

2. Concealed surfaces such as walls or ceilings in concealed areas and inaccessible areas, furred areas, pipe spaces, and duct shafts.

3. Finished metal surfaces such as anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials, exterior aluminum entrances, storefronts, and windows.

4. Integral color portland-cement plaster.

5. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts.

C. Following categories of work are included under other Sections:

1. Shop priming ferrous metal items including structural steel, metal fabrications, hollow metal work and similar items. The work of this Section includes sanding and applying specified primer on all shop-primed surfaces exposed to view in the completed work.

2. Shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories.

3. Piping identification is specified in Division 22.

4. Graffiti-resistant coatings are specified in Section 09 96 23.

D. Do not paint over code-required labels, equipment identification, performance rating, name, or nomenclature plates.

E. Related Sections:

1. Common product requirements are specified in Section 01 61 00.

2. Construction waste management is specified in Section 01 74 19.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Certification: Furnish certification by the paint manufacturer that products supplied comply with local regulations controlling the use of volatile organic compounds (VOCs).

C. Samples: Furnish samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture is achieved.

2. Furnish samples on the following substrates for review of color and texture only:

a. Painted Wood: Two 12-inch square samples of each color and material on hardboard.

b. Stained or Natural Wood: Two 4-inch x 8-inch samples of natural and stained wood finish on actual wood samples.

D. Product Data: Specified paint systems are those of Benjamin Moore, Dunn Edwards, Frazee, Kelly Moore, Sherwin Williams and Vista. If other paint manufacturers are proposed and accepted by the Architect, furnish product comparison charts showing that proposed paint systems are equal to the specified materials in number of coats, type of paint, and sheen.

1.03 QUALITY ASSURANCE

A. Applicators Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent.

B. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommended limits.

C. Coordination of Work: Review other Sections in which prime paints are to be provided to ensure compatibility of coatings system for various substrates. Upon request, furnish information or characteristics of finish materials to be used.

D. Requirements of Regulatory Agencies: Comply with applicable rules and regulations of governing agencies for air quality control.

1. Comply with current applicable regulations of the local air quality district, California Air Resources Board (CARB) and the Environmental Protection Agency (EPA).

2. Regulatory changes may affect the formulation, availability, or use of specified coatings. Confirm availability of coatings to be used prior to start of painting.

E. Field Samples: On interior and exterior wall surfaces provide full-coat finish samples on at least 100-sq. ft. of surface, as directed, until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work. Approved samples will be used as a standard for the Project.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Section 01 61 00.

B. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name, batch number, color, and directions.

C. Store materials in tightly covered containers. Maintain containers in a clean condition, free of foreign materials

and residue.

D. Keep storage area neat and orderly. Remove oily rags and waste daily. Ensure that workers and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.05 JOB CONDITIONS

A. Apply water-base paints when temperature of surfaces to be painted and surrounding air temperatures are between 50-deg. F. and 90-deg. F., unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45-deg. F. and 90-deg. F., unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not apply paint in rain, fog or mist, when relative humidity exceeds 85-percent, or when temperature is less than 5-deg. F. above dew point, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

D. Provide adequate ventilation during interior painting using as close to 100-percent outside air as possible.

1.06 EXTRA MATERIALS

A. In addition to materials for completion of the work, furnish 5-gallons of additional materials for each type and color of opaque paint used.

B. Furnish extra materials from same production lots or color runs used in the work. Furnish in containers factory sealed and labeled. Identify each container with Project name and type of material.

C. Deliver materials and an inventory list just prior to Substantial Completion and store where directed by Owner.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. ICI, Glidden, or approved equal with Zero VOC.

2.02 MATERIALS

A. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application.

B. Material Quality: Provide best quality grade of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable. Each product within any one paint system shall be from the same manufacturer.

2.03 COLORS AND SHEENS

A. Colors and sheens are indicated on the Drawings.

B. Colors and sheens not scheduled shall match color chips furnished by the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting is to be applied. Surfaces receiving paint shall be thoroughly dry before paint is applied.

1. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect prior to applying barrier coats.

2. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning.

3. Start of painting will be construed as the applicator's acceptance of surfaces and conditions within a particular area.

3.02 PROTECTION

A. Protection: Protect work of other Sections against damage by painting and finishing work. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

2. Remove or protect hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting. Following completion of painting, reinstall removed items.

3. At completion of work of other Sections, touch-up and restore damaged or defaced painted surfaces.

3.03 SURFACE PREPARATION

A. Concrete and Masonry:

1. Prepare surfaces to be painted by removing surface contaminates.

a. Remove efflorescence with stiff bristle brush, wire brushing, wiping, sandblasting or acid washing and rinsing. Allow to dry.

b. Remove chalk, dust, dirt, asphalt, tar or excessive mortar by scraping or wire brushing.

c. Remove rust, grease or oil by solvent cleaning or sandblasting.

d. Treat concrete surfaces which are highly glazed or where traces of form release agents are present with a preparation of one-part concentrated muriatic acid, 4-parts water and one-part detergent or as recommended by parting compound manufacturer. Remove acid with water. Allow to dry.

e. Remove stains on concrete resulting from weathering or corroded metals, with a solution of 2-oz. sodium methasilicate in one-gallon water. Wet stained areas with water before application of solution. Allow to dry.

B. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dry.

2. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.

3. When transparent finish is required, back-prime with spar varnish.

4. Back-prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.

5. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.

C. Ferrous Metal: Clean ungalvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease,

dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of The Society for Protective Coatings (SSPC).

1. Blast surfaces clean as recommended by the paint system manufacturer and according to requirements of SSPC specification SSPC-SP 10.

2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

3. Sand shop-applied prime coats to a smooth surface, ready to receive specified primer and finish coats.

D. Galvanized Metals: Clean with non-petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

E. Gypsum Board: Clean surfaces of dust, dirt, grease, oil and other foreign matter and dust clean.

F. Existing Surfaces to be Repainted: Thoroughly clean and de-gloss surfaces to be repainted by sanding or other means prior to painting. Patched and bare areas shall be shop-primed with same alkyd primer as specified for new work.

3.04 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using.

D. Use thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.05 APPLICATION

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Provide finish coats compatible with prime coats.

2. The number of coats required is the same regardless of the application method. Do not apply following coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where required to produce a smooth even surface.

3. Apply additional coats when undercoats, stains or other conditions show through final coat, until paint film is of uniform finish, color and appearance. Edges, corners, crevices, welds, and exposed fasteners shall receive a dry film thickness equivalent to that of flat surfaces.

4. Paint surfaces behind movable equipment and furniture.

5. Paint surfaces behind permanently-fixed equipment or furniture with prime coat before final installation of equipment.

6. Paint visible surfaces of ducts where visible through registers or grilles with a flat, non-specular black paint.

7. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

8. Finish doors on top, bottom and side edges same as faces. Where openings into rooms have different finishes, finish door edges as directed by the Architect.

9. Omit primer on metal surfaces that have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation.

1. Allow sufficient time between successive coatings to permit proper drying.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's instructions.

1. Brushes: Use brushes best suited for the material applied.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate.

E. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces. Finish to match adjoining wall or ceiling surfaces.

1. Mechanical items to be painted include, but are not limited to, piping, hangers, and supports; heat exchangers; tanks; ductwork; insulation; supports; motors and mechanical equipment; air grilles and diffusers; and accessory items.

2. Electrical items to be painted include, but are not limited to conduit and fittings, panels, and switchgear.

F. Block Filler: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores completely filled flush, free of pinholes. Provide multiple coats if required.

G. Prime Coats: Before applying finish coats, apply a prime coat. Re-coat primed and sealed surfaces where there is evidence of suction spots or unsealed areas to assure a finish coat with no burn-through or other defects.

H. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.

I. Transparent (Clear) Finishes: Use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

J. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.06 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during painting.

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. The testing laboratory will perform appropriate tests for material analysis, abrasion resistance, reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated

yellowness, re-coating, skinning, color retention, alkali and mildew resistance, and application to specified mil thickness.

3. If test results show material being used does not comply with specified requirements, the Contractor may be directed to stop painting, remove non-complying paint, pay for testing, repaint surfaces coated with rejected material, and remove rejected material from previously painted surfaces if, upon re-painting with specified paint, the two coatings are incompatible.

3.07 CLEANING

A. Clean-Up: During progress of work, remove discarded paint materials, rubbish, cans and rags at end of each work day.

B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by washing and scraping; do not scratch or damage finished surfaces.

C. Do not dispose of paints or solvents by pouring on the ground. Place in designated containers for proper disposal.

END OF SECTION

SECTION 09 97 13

STEEL COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and applying special coatings on the following:

1. Interior metal items, including but not limited to the following:

a. Metal doors, door frames, and window frames.

b. Metal railings and handrails.

2. Exterior metal items, including but not limited to the following:

a. Metal doors, door frames, and window frames.

b. Metal railings and handrails.

c. Miscellaneous items indicated to receive special coating.

B. Related Sections:

1. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's descriptive data fully describing each product to include solids by volume and complete test data comparable to specified products. Include manufacturer's recommendations for mixing, thinning and curing.

C. Certificates: Manufacturer's certified test reports confirming compliance with specified performance requirements.

D. Samples: Two 5- inch x 7-inch samples of each selected color. Resubmit until approved by the Architect.

1.03 QUALITY ASSURANCE

A. Applicator: Applicator shall have a minimum of 3-years experience in the application of special coatings of the types required for this Project.

B. Job Mock-Up:

1. Minimum 50 sq. ft. application of each specified coating system on each type of substrate.

2. Mock-ups will serve as standard for acceptance of work.

3. Leave approved mock-ups in place as part of completed Project.

1.04 PRODUCT DELIVERY, STORAGE, HANDLING:

A. General: Comply with Section 01 61 00.

B. Deliver materials in factory-sealed containers with manufacturer's labels intact and legible.

C. Store materials in a protected area at a temperature between 40-deg. F. and 110-deg. F.

1.05 JOB CONDITIONS

A. Apply coating only under the following prevailing conditions:

1. The air and surface temperatures are not below 50-deg. F. or above 120-deg. F.

2. Relative humidity is not above 85-percent and the surface temperature is at least 5-deg. F. above the dew point.

B. Protect surfaces not to be coated.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURER

A. Tnemec Company (866) 317-3206 as specified, Ameron, Rust-Oleum or approved equal.

2.02 MATERIALS

A. Urethane Zinc rich Primer for Exterior Applications: Tnemec 90 97 Tneme Zinc.

1. Adhesion: Not less than 1,500-psi pull, average of three trials, ASTM D4541 Type II

2. Salt Spray (Fog): No blistering, cracking, spot rusting or delamination of film after 10,000-hours exposure, ASTM B117.

3. Zinc dust shall meet requirements of ASTM D 520 Type III

4. Metallic Zinc Content: 83.0-percent + or - 2 by weight in dry applied film.

5. VOC Content, Unthinned: 321 g/L.

B. Organic Zinc-rich Primer for Interior Applications: Tnemec 90-94 Hydro-Zinc.

1. Adhesion: Not less than 1,500-psi pull, average of three trials, ASTM D4541, Type II.

2. Salt Spray (Fog): No blistering, cracking, spot rusting or delamination of film after 10,000-hours. No more than 1/64-inch rust creep at scribe and no rusting at edges after 3,000-hours exposure, ASTM B117.

3. Solids by Volume: Not less than 62-percent + or – 2-percent.

4. Zinc Dust Content: 83.0-percent + or – 2 by weight in dry applied film.

5. Zinc dust shall comply with ASTM D520 Type III.

6. VOC Content: Not more than 100 g/L.

C. Polyamidoamine Epoxy, Series V69 Hi-Build Epoxoline II.

1. Abrasion: No more than 140-mg loss after 1,000-cycles, ASTM D4060, CS-17 Wheel, 1,000-gram load.

2. Adhesion: Not less than 1,600-psi, ASTM D4541, Type II Fixed Alignment Adhesion Tester.

3. Humidity: No blistering, cracking, softening or delamination of film after 1,000-hours, ASTM D4585.

4. Salt Spray (Fog): No blistering, cracking, or delamination of film. Not more than 1-percent rusting on plane. Not more than 1/16-inch rust creep at scribe after 6,700-hours exposure, ASTM B117.

5. Solids by Volume: Not less than 67-percent + or – 2-percent.

6. VOC Content: Not more than 250 g/L.

D. Polyamidoamine Cured Epoxy, Series L69 Epoxoline.

1. Adhesion: No more than 140-mg loss after 1,000-cycles, ASTM D4060, CS-17 Wheel, 1,000-gram load.

2. Salt Spray (Fog): No blistering, cracking or delamination of film after 5,000-hours, ASTM B117.

3. Adhesion: ASTM D4541, Type II, not less than 1,500-psi pull average of 3 trials.

4. Solids by Volume: Not less than 65-percent + or – 2-percent (mixed).

5. VOC Content: Not more than 100 g/L.

E. Aliphatic Acrylic Polyurethane, Series 1075 Endura-Shield II.

1. Abrasion: No more than 139-mg. loss after 1,000-cycles, ASTM D4060, CS-17 Wheel, 1,000-grams load.

2. Adhesion: Not less than a rating of 5, average of three tests, ASTM D3359 Method B.

3. Humidity: No blistering, cracking, softening or delamination of film after 4,000-hours, ASTM D4585.

4. Salt Spray (Fog): No blistering, cracking, rusting or delamination of film. Not more than 1/16-inch rust creep at scribe after 2,000-hours exposure, ASTM B117.

5. Solids by Volume: Not less than 71-percent + or – 2-percent.

6. QUV: No blistering, cracking or chalking. No less than 98-percent gloss retention and 2.25 DED FMCII color change after 5,000-hours exposure, ASTM D4587.

7. VOC Content: Not more than 250 g/L.

F. Waterborne Acrylic Polyurethane, 1081 (semi-gloss) or 1080 (gloss) Endura-Shield WB.

1. Abrasion: No more than 83-mg. loss average or three trials after 1,000-cycles, ASTM D4060, CS-17 Wheel, 1,000-grams load.

2. Adhesion: No less than 1,650-psi average of three trials, ASTM D4541, Type II.

3. Humidity: No blistering, cracking, softening or delamination of film after 2,000-hours, ASTM D4585.

4. Salt Spray (Fog): No blistering, cracking, softening or delamination of film and no more than 1/32-inch rust creepage at scribe after 5,000-hours exposure, ASTM B117.

5. QUV: No blistering, cracking or chalking. No less than 98-percent gloss retention and 2.25 DED FMCII color change after 5,000-hours exposure, ASTM D4587.

6. VOC Content: Not more than 100 g/L.

2.03 MATERIAL PREPARATION

A. Mix and thin materials according to manufacturer's latest printed instructions.

B. Do not use materials beyond manufacturer's recommended shelf life.

C. Do not use mixed materials beyond manufacturer's recommended pot life.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine surfaces to be coated and report conditions that would adversely affect appearance or performance of coating systems and which cannot be put into an acceptable condition by preparatory work as specified. Conduct test patches per ASTM D5064 to ensure compatibility of new coating over existing paint.

B. Do not proceed with surface preparation and application until surface is acceptable or authorization to proceed is given by Architect.

3.02 SURFACE PREPARATION

A. General:

1. Dislodge dirt, rust, mortar spatter and other dry material by scraping or brushing. Remove dust and loose material by brushing, sweeping, vacuuming or blowing with high-pressure air.

2. Remove oil, wax and grease by scraping off heavy deposits and cleaning with mineral spirits or a hot trisodium phosphate solution followed by a water rinse.

3. Verify that surfaces to be coated are dry, clean and free of dust, dirt, oil, wax, grease or other contaminants.

B. Galvanized and Zinc Electroplated Steel:

1. For Normal Interior Dry and Normal Exterior Exposure:

a. When no passivator is present on the galvanized surface, clean per SSPC-SP1 (Solvent Cleaning) then either chemical etch using Clean ‘n Etch or Galvaprep 5 or brush blast per ASTM D6386.

b. Where passivators are present or their presence is unknown, brush blast per ASTM D6386.

2. For interior other than dry and benign (frequently wet, chemical exposure, over a pool, etc.), exterior corrosive environment (near salt water) and all immersion service, brush-off blast per ASTM D6386 to a profile/anchor pattern between 1.0- and 1.5-mils.

3. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods, then chemical etch using Clean 'n Etch or Galvaprep 5.

C. Non-galvanized Steel:

1. Exposed surfaces and surfaces specified to receive zinc-rich primers shall be cleaned in compliance with SSPC-SP6 and receive coating before rusting occurs.

a. Surfaces within 5-feet of open bodies of saltwater shall be cleaned in accordance with SSPC-SP10.

3.03 APPLICATION

A. Apply a stripe coat to all edges and welds prior to the application of first full primer or finish coat.

B. Apply materials at specified film thickness by method recommended by manufacturer. At perforated metal, apply material at thinner film thickness and increase the number of coats if required to eliminate filling perforations with coating and as required for acceptable coverage and appearance.

C. Allow each coat to dry thoroughly before recoating. Follow manufacturer's recommended recoat time.

D. Cut edges clean and sharp where work joins other materials or colors.

E. Make finish coats smooth, uniform in color, and free of brush marks, laps, runs, dry spray, overspray and skipped or missed areas.

3.04 INSPECTION

A. Request acceptance of each coat before applying succeeding coats.

B. Repair and touch-up work that is not acceptable to the Architect and request final acceptance.

3.05 CLEANING

A. Remove paint spatters from glass, plumbing fixtures and adjoining surfaces.

B. Repair damage to coatings or surfaces caused by cleaning operations.

C. Remove debris from jobsite and leave storage areas clean.

3.06 COATING SCHEDULE

A. Exterior Use (Non-galvanized Steel):

1. First Coat: 90-97 Tneme-Zinc at 2.5- to 3.0-mils dry film thickness.

2. Second Coat: Series N69 Hi-Build Epoxoline at 2.0- to 3.0-mils dry film thickness.

3. Third Coat: Series 1075 Endura-Shield at 2.0- to 3.0-mils dry film thickness.

4. Fourth Coat: Series 1075 Endura-Shield at 2.0- to 3.0-mils dry film thickness.

Note: Third and fourth coats may be spray applied as a single 4.0- to 5.0-mil dry film thickness coat provided surface finish requirements are maintained.

B. Exterior Use (Galvanized and Zinc Plated Steel):

1. Touch-up Damaged Galvanized Surfaces: 90-97 Tneme-Zinc at 2.5- to 3.5-mils dry film thickness.

2. First Coat: Series N69 Hi-Build Epoxoline at 2.0- to 3.0-mils dry film thickness.

3. Second Coat: Series 1075 Endura-Shield at 2.0- to 3.0-mils dry film thickness.

4. Third Coat: Series 1075 Endura-Shield at 2.0- to 3.0-mils dry film thickness.

Note: Second and third coats may be spray applied as a single 4.0- to 5.0-mil dry film thickness coat provided surface finish requirements are maintained.

C. Interior Non-Galvanized Steel:

1. First Coat: 94-H2O Hydro-Zinc at 2.5- to 3.5-mils dry film thickness.

2. Second Coat: Series L69 Hi-Build Epoxoline at 2.0- to 3.0-mils dry film thickness.

3. Third Coat: Series 1080/1081 Endura-Shield WB at 2.0- to 3.0-mils dry film thickness.

4. Fourth Coat: Series 1080/1081 Endura-Shield WB at 2.0- to 3.0-mils dry film thickness.

Note: Third and fourth coats may be spray applied as a single 4.0- to 5.0-mil dry film thickness coat provided surface finish requirements are maintained.

D. Interior Galvanized and Zinc Plated Steel:

1. Touch-up of Damaged Galvanized Surfaces: 94-H2O Hydro-Zinc at 2.5- to 3.0-mils dry film thickness.

2. First Coat: Series N69 Hi-Build Epoxoline at 2.0- to 3.0-mils dry film thickness.

3. Second Coat: Series 1080/1081 Endura-Shield WB at 2.0- to 3.0-mils dry film thickness.

4. Third Coat: Series 1080/1081 Endura-Shield WB at 2.0- to 3.0-mils dry film thickness.

Note: Second and third coats may be spray applied as a single 4.0- to 5.0-mil dry film thickness coat provided surface finish requirements are maintained.

END OF SECTION

SECTION 10 11 00

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following types of visual display surfaces:

1. Porcelain enamel markerboards.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's technical data and installation instructions for each material and component part, including data substantiating that materials comply with specified requirements. Include data on regular cleaning, stain removal and precautions.

C. Shop Drawings: Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout and installation details.

D. Samples: Full range of color samples for each type of markerboard, tackboard, trim and accessory. Furnish 12-inch square samples of sheet materials and 12-inch lengths of trim members for color verification after selections have been made.

1.03 QUALITY ASSURANCE

A. Manufacturer: Minimum 5-years experience in the manufacture of visual display units.

B. Installer Qualifications: Engage an experienced installer who is an authorized representative of the manufacturer for both installation and maintenance of sliding units.

1.04 PROJECT CONDITIONS

A. Field measure prior to preparation of shop drawings and fabrication to ensure proper fit.

B. Comply with manufacturer’s recommendations for acclimating area for interior moisture and temperature to approximate normal occupied conditions.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Section 01 61 00.

B. Schedule delivery of visual display boards with spaces sufficiently complete so that visual display boards can be installed upon delivery.

C. Store products in manufacturer’s unopened packaging until ready for installation.

D. Store materials protected from exposure to harmful weather conditions and at temperatures and humidity conditions recommended by manufacturer.

1.06 WARRANTY

A. Warrant markerboards to be free from defects in materials and workmanship for the life of the building. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Porcelain Enamel Markerboards: Aywon Chalkboard & Corkboard, Inc., Claridge Products and Equipment, Inc., Marsh Industries, Moore Co. “Sharewall” or approved equal.

B. Tackboards: Aywon Chalkboard & Corkboard, Inc., Claridge Products and Equipment, Inc., Marsh Industries or

2.02 PORCELAIN ENAMEL MARKERBOARDS

A. Face Sheet: Enameling grade cold rolled steel manufactured from a minimum of 30-percent post-consumer and post-industrial waste.

1. Enameling grade steel shall be coated with a 3-coat process as follows:

a. Bottom Ground Coat: 1.5- to 2.2-mils.

b. Top Ground Coat: 2.0- to 2.8-mils.

c. Top Cover (Color) Coat: 3.0- to 4.0-mils, intended for use with liquid felt-tipped markers.

2. Firing Temperature: Lowest possible temperature to reduce steel and porcelain stresses and achieve superior enamel and hardness.

3. Color: As selected by the Architect from manufacturer’s standards.

B. Core:

1. 7/16-inch thick medium density fiberboard (MDF) composed of approximately 90-percent post-industrial waste.

2. 7/16-inch thick Duracore manufactured from 100-percent reclaimed or recycled wood fiber, including 3-percent post-consumer wood fiber. Duracore shall contain no added urea-formaldehyde resins.

C. Backing Surface: Moisture barrier, foil, aluminum sheet or steel.

D. Metal Trim and Accessories: Minimum 0.062-inch thick aluminum. Provide straight, single-length units wherever possible. Miter corners to a neat, hairline closure.

1. Field-Applied Trim: Manufacturer's standard screw-on trim with Phillips flat-head screws. Provide tamper-resistant fasteners where indicated.

2. Chalktray: Manufacturer's standard continuous solid extrusion-type with ribbed section and smoothly curved exposed ends.

3. Map Rail: Furnish map rail at the top of each unit, complete with the following:

a. Display Rail: Continuous cork display rail, approximately 1- or 2-inches wide, integral with the map rail.

b. End Stops: Provide one end stop at each end of the map rail.

c. Map Hooks: Provide 2 map hooks for each 4-feet of map rail.

4. Finish aluminum trim and accessories with clear anodized finish.

5. Furnish each markerboard with 12 assorted color markers and a felt eraser.

2.03 TACKBOARDS

A. Linoleum Sheet:

1. Approved Manufacturer: Forbo Flooring, Inc. “Bulletin Board” or approved equal.

2. Material: Homogeneous tackable surface material made of primary natural materials consisting of linseed oil, cork, rosin binders and dry pigments mixed and calendared onto a natural jute backing.

3. Thickness: 1/4-inch.

4. Pattern and Color: As selected by the Architect.

B. Adhesive: Forbo Flooring, Inc. L 910W Adhesive or as recommended by linoleum sheet manufacturer.

C. Metal Trim and Accessories: Minimum 0.062-inch thick aluminum. Provide straight, single-length units wherever possible. Miter corners to a neat, hairline closure.

1. Field-Applied Trim: Manufacturer's standard screw-on trim with Phillips flat-head screws. Provide tamper-resistant fasteners where indicated.

2. Finish aluminum trim and accessories with clear anodized finish.

2.04 SLIDING AND HINGED MARKERBOARD PANELS

A. Face Sheet: Enameling grade cold rolled steel manufactured from a minimum of 30-percent post-consumer and post-industrial waste.

1. Enameling grade steel shall be coated with a 3-coat process as follows:

a. Bottom Ground Coat: 1.5- to 2.2-mils.

b. Top Ground Coat: 2.0- to 2.8-mils.

c. Top Cover (Color) Coat: 3.0- to 4.0-mils, intended for use with liquid felt-tipped markers.

2. Firing Temperature: Lowest possible temperature to reduce steel and porcelain stresses and achieve superior enamel and hardness.

3. Finish: White, low gloss.

B. Core:

1. 7/16-inch thick medium density fiberboard (MDF) composed of approximately 90-percent post-industrial waste.

2. 7/16-inch thick Duracore manufactured from 100-percent reclaimed or recycled wood fiber, including

3-percent post-consumer wood fiber. Duracore shall contain no added urea-formaldehyde resins.

C. Backing Surface: Moisture barrier, foil, aluminum sheet or steel.

D. Metal Trim and Accessories: Minimum 0.062-inch thick aluminum. Provide straight, single-length units wherever possible. Miter corners to a neat, hairline closure. Provide steel spline joints between panels.

1. Field-Applied Trim: Manufacturer's standard screw-on trim with Phillips flat-head screws. Provide tamper-resistant fasteners where indicated.

2. Finish aluminum trim and accessories with clear anodized finish.

E. Hardware:

1. Sliding Panels: Hafele HAWA JR SoftMove sliding door hardware or approved equal.

2. Hinged Panels: To be selected by the Architect. Provide bottom wheels where required for panel size and weight.

2.05 FABRICATION

A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with flexible, waterproof adhesive.

B. Provide factory-assembled units unless otherwise acceptable to the Architect.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Deliver factory-built units completely assembled in one piece without joints.

B. Install units as indicated and in accordance with manufacturer's instructions. Maintain perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories required for installation.

C. Tackboards:

1. Prepare substrate in accordance with manufacturer’s instructions.

2. Cut material to required length, allowing 2- to 3-inch overlap. Lay sheets flat to acclimate for 24-hours prior to installation. Back roll sheets once ion reverse direction to release roll stretch. Remove the factory edge from both sides of the material.

3. Apply adhesive to and place sheet into wet adhesive and roll with a 100-pound roller.

3.02 ADJUST AND CLEAN

A. Verify that accessories required for each unit have been properly installed.

B. Clean units in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following types of signs:

1. Dimensional letters and numbers.

2. Room identification signs.

3. Tactile exit signs.

4. International symbol of accessibility.

1.02 SUBMITTALS

A. General: Comply with Section 01 33 00.

B. Product Data: Manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

C. Shop Drawings: Furnish shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

1. Furnish message list for each sign required, including large scale details of wording and layout of lettering.

2. For signs supported by or anchored to permanent construction, furnish setting drawings, templates, and directions for installation of anchor bolts and other anchors.

3. Furnish full-size spacing templates for individually mounted dimensional letters and numbers.

D. Samples: Furnish samples of each exposed material, including letters and other graphics, showing finish, color, and qualities of fabrication and design.

1.03 QUALITY ASSURANCE

A. Comply with California Building Code (CBC) Section 1117B.5.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION

A. Acrylic Sheet: Transparent, clear, semi-matte or non-glare, thickness specified.

B. Aluminum Sheet: Alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated and specified.

C. Aluminum Extrusions: Alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated and specified.

D. Stainless Steel Plate, Sheet, and Strip: Provide stainless steel plate, sheet, or strip, AISI Type 302, complying with ASTM A167.

E. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

F. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors that are recommended by acrylic manufacturer for optimum adherence to acrylic surface and are non-fading for the application intended.

G. Interior Signage:

1. Signs shall be sign manufacturer's standard one piece photopolymer sign face with tactile Braille and letters or acrylic sign face with applied tactile lettering and Braille, at manufacturer's option, and shall be interior rated.

2. Sign materials and fabrication shall comply with applicable CBC and ADA signage requirements.

3. Sign Finish: Eggshell, matte, or non-glare as selected by the Architect.

4. Copy: 5/8-inch minimum, 2-inch maximum as recommended by sign manufacturer for required copy, raised minimum 1/32-inch.

5. Letters: San Serif, style as indicated or as selected by the Architect.

6. Braille: Contracted Grade 2 Braille complying with CBC Section 1117B.5.6.

7. Mounting: Tamper-resistant mechanical fasteners.

H. Style of new interior signage shall match existing signage at the East Wing of the building.

2.02 SIGN SUMMARY

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A. Room Identification Signs:

1. Provide one sign adjacent to latch side of doors or on the nearest adjacent wall where indicated. Signs shall identify room name as directed by the Architect.

2. Provide signs with raised upper case letters with Grade 2 Braille. Comply with ADA Article 4.30.

3. Mount signs 60-inches above finish floor to centerline of sign.

4. Comply with CBC Section 1117B.5.1.1.

B. International Symbol of Accessibility:

1. Design: As indicated in CBC Figure 11B-6.

2. Color: White figure on a blue background. Blue color equal to Color No. 15090 in Federal Standard 595B.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Locate where indicated and as required by applicable codes and secure with specified fasteners.

B. Install level, plumb and at height indicated or required, with surfaces free from distortion or other appearance defects.

C. Dimensional Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by manufacturer. Provide template to establish letter spacing and to locate holes for fasteners.

1. Mount letters with backs in contact with wall surface or projected from the wall surface as indicated.

3.02 CLEANING AND PROTECTION

A. At completion of installation, clean soiled surfaces in accordance with manufacturer's instructions. Protect units from damage until final acceptance.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fire extinguishers; fire extinguisher cabinets; and brackets for wall mounting.
B. This standard is provided to obtain and maintain adequate, approved fire protection for Stanford University. Any questions regarding this standard shall be directed to the Stanford University Fire Marshal's Office (SUFMO).
C. In general, all fire protection design issues are subject to internal review and approval by SUFMO.

1.2 REFERENCES

A. Fire Extinguishers Study Guide, as published by the Office of State Fire Marshal.

B. UL (Underwriters Laboratories, Inc.) - Fire Protection Equipment Directory

C. CCR Title 19, CCR Title 24

D. NFPA 10

1.3 SUBMITTALS

A. Architectural Drawings: All fire extinguisher (FE) locations shall be shown on the drawings and indicate whether FE's are to be in cabinet(s) or wall mounted. Provide product data submittals for all cabinets to be installed as part of the project to SUFMO for approval prior to purchase.

B. The Project Manager will submit the drawings to SUFMO for approval as part of the normal SUFMO review process. After receiving comments, the contractor shall make appropriate changes to the drawings. For any requirements not implemented, design consultant/contractor shall provide an explanation in writing.

C. Manufacturer's data sheets for all types of fire extinguisher cabinets, signs and other accessories shall be submitted. Exact model shall be indicated on the data sheet when more than one model is shown.

1. Include physical dimensions, operational features, color and finish, anchorage details, rough-in measurements, location and details.

D. Record Drawings: At project close-out, the Contractor shall provide to the Project Manager a record set of drawings that includes the location of each extinguisher and other installed hardware on the final floor plans.

1.4 QUALITY ASSURANCE

A. Competency Quotation: The work shall be performed by a Contractor who shall have had at least 5 years successful installing cabinets, brackets signs and other accessories of similar make and similar model. The Project Manager may reject any proposed installer who cannot show evidence of such qualifications.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Interior cabinets shall only be located in interior locations. Exterior locations shall utilize weather-proof cabinets.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS – Fire Extinguishers are Stanford furnished items and will be charged to the single project work request/work order; a separate work request is not required. Fire protection cabinets are to be furnished and installed by the Contractor. The fire extinguishers are furnished, tagged and installed by SUFMO or the Contractor.

A. Minimum Type and Location:
   1. 3A-40BC extinguishers in all common areas, elevator control rooms, generators and at electric vehicle charging stations as required by SUFMO.
   2. 5lb CO_2 extinguishers in all wet chemical labs. 10lb CO_2 extinguishers in all main mechanical and electrical rooms.
   3. Class K to be located in kitchens equipped with deep fat fryers within 30' of the hood being served.
   4. 40BC extinguishers to be located in kitchens without deep fat fryers.
   5. Data Centers, Communication Hubs – type as required by SUFMO.
   6. Magnet Rooms – Non-magnetic Clean Guard or Water Mist extinguisher is required to protect MRI equipment. All other fire extinguishers in proximity to an MRI or magnetic devices shall be a non-magnetic type of extinguisher.

B. Halon: Not permitted for new installations.

C. Water Type: For exterior use only as approved by SUFMO.

D. Special Hazard Conditions: type as required by SUFMO.

E. The minimum number of extinguishers and spacing shall be as required by Title 19. The preferred location for extinguishers is adjacent to exits and in the corridors and main egress paths.

2.2 FIRE EXTINGUISHER CABINETS

A. Configuration: Recessed or Semi-Recessed
Exception: Exterior weather-proof cabinets may be surface mounted.

B. Door: Latch access only, key lock access is not acceptable. Cabinet doors shall be equipped with a vision panel.

C. Door Glazing: Break glass type cabinets are not acceptable.

D. Cabinet interiors to have a minimum clear space of 18 inches high by 8 inches wide and capable of containing the specified fire extinguisher.

E. Cabinet Finish: Project Architect shall specify finish type available from the manufacturer.

PART 3 EXECUTION

3.1 EXTINGUISHER INSTALLATION

A. Extinguishers: Installed by SUFMO or the Contractor

3.2 CABINET INSTALLATION

A. Prepare structural members of backing as required for mounting screws.

B. Installation of cabinets using nails is not acceptable.

C. Ensure cabinets are secured rigidly in place in accordance with manufacturer's instructions. Minimum of two screws each at both the top and bottom of the rear of the cabinet anchored to building structural members or

backing attached to structural members. Verify that the cabinet mounting holes line up with structural members or backing.

D. Install fire extinguishers in cabinets at the completion of construction. Cabinets shall be located so that the hinge door has a clear opening dimension of 180 degrees.

E. Fire extinguisher cabinets shall be installed so that the bottom of the cabinet is not more than 2 ft. above the floor.

F. Signs shall be installed wherever extinguishers are not readily visible to identify their location. Where cabinets are used signs shall be installed to identify location along the corridor or hallway.

3.3 BRACKET INSTALLATION

A. Brackets for hanging fire extinguishers will normally be installed by SUFMO.

B. Alternate installation methods shall be reviewed and approved by SUFMO.

3.4 WARRANTY

A. Contractor shall warranty cabinets, accessories, and workmanship for a period of one (1) year from the date of final acceptance.

END OF SECTION

SECTION 230500 - BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and shall include all Mechanical Sections specified herein.

1.2 SCOPE OF THIS SECTION

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Compliance with all codes and standards applicable to this jurisdiction
2. Shop Drawings for Equipment
3. Coordination Documents
4. Record Drawings
5. Start-up Service and Building Commissioning
6. Instruction, Maintenance, and O & M Manuals
7. Work associated with Delivery, Storage, and Handling of products
8. Work associated with provision of Temporary Facilities
9. Preparation of Posted Operating Instructions
10. Meeting Project Safety and Indemnity requirements
11. Proper Cleaning and Closing
12. Supplying proper Warranty information
13. Supply specified Guarantee documentation
14. Design and provision of Supports and Anchors
15. Pipe Portals
16. Pipe Supports
17. Equipment Rails
18. Access Panels and Doors
19. Identification Markers
20. Coordination of Electrical requirements for equipment provided

1.3 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to provide all material and labor to install complete heating, ventilating, air conditioning systems for the building and shall interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and shall coordinate this work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipe lines and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

C. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

D. Where project involves interface with existing building and site systems, every effort has been made to note existing utilities and services. However, the Contractor should thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

1.4 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

1. Specifications, in general, describe quality and character of materials and equipment.
2. Specifications are of simplified form and include incomplete sentences.

B. Drawings:

1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation.
2. Before proceeding with work check and verify all dimensions.
3. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
4. Make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.
5. Where existing pipes, conduits and/or ducts prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits and/or ducts. Verify exact location and elevation of existing piping prior to any construction.
6. If any part of Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative interpretation and decision as early as possible, including during bidding period.

1.5 DEFINITIONS

A. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

B. "Accessible": Ability to perform recommended maintenance without removal of services or equipment and requiring no special platforms.

C. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

D. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

E. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

F. "Connect": Complete hook-up of item with required service.

G. "Exposed": Not installed underground or "concealed."

H. "Furnish": To supply equipment and products as specified.

I. "Indicated," "Shown" or "Noted": As indicated, shown or noted on Drawings or Specifications.

J. "Install": To erect, mount and connect complete with related accessories.

K. “Motor Controllers”: Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

L. "Must": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

M. “NRTL”: Nationally Recognized Testing Laboratory, including UL and/or ETL.

N. “Piping”: Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

O. “Provide”: To supply, install and connect as specified for a complete, safe and operationally ready system.

P. “Reviewed,” “Satisfactory” or “Directed”: As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner’s Representative.

Q. “Rough-In”: Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

R. “Shall”: An exhortation or command to complete the specified task.

S. “Similar” or “Equal”: Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

T. “Supply”: To purchase, procure, acquire and deliver complete with related accessories.

U. “Typical” or “Typ”: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

V. “Will”: A desire to complete the specified task. Allows some flexibility in application as opposed to “Shall”.

W. “Wiring”: Raceway, fittings, wire, boxes and related items.

X. “Work”: Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 23 Mechanical sections included herein.

B. Division 33: Utility Site Work.

1. Coordination of excavation of trenches and the installation of mechanical systems and piping on site.

C. Division 03: Concrete.

1. All concrete work required for plumbing work shall be coordinated by Division 23 with Division 03 including:

a. Concrete curbs and housekeeping pads for the mechanical equipment.
b. Thrust blocks, pads, and boxes for mechanical equipment.

D. Division 07: Thermal and Moisture Protection.

1. Flashing and sheet metal
2. Sealants and caulking

3. Firestopping

E. Division 09: Painting:

1. Division 23 shall coordinate with Division 09 to perform all painting, except where specifically stated otherwise in Division 09.
2. Painting of all exposed steel, piping, ductwork, insulation, equipment and materials
3. Paint all exposed gas piping, interior and exterior to the building, yellow.

F. Division 10: Miscellaneous Metals.

1. Exterior louvers and grilles shall be included in this Section.

G. Division 26: Electrical is related to work of:

1. Power connections to all mechanical equipment

H. Division 28: Electronic Safety and Security is related to work of:

1. Fire protection alarms and relays
2. Smoke detector and monitoring
3. Life Safety Systems

1.7 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 23 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All accessible mechanical work shall comply with the minimum requirements of the Americans with Disabilities Act (ADA) and local amendments. Compliance requirements applicable to HVAC work includes, but is not limited to, the following:

1. Section 309: Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 5 pounds maximum.
2. Section 308.3: Temperature control devices mounted on walls with operable buttons or switches shall be placed where clear floor or ground space allows a parallel approach and the side reach is unobstructed. Operable parts shall be located 48” maximum above finished floor.
3. Section 308.3.2: Where a clear floor or ground space allows a parallel approach to an element and high reach is over an obstruction, the height of the obstruction shall be 34” maximum and depth of obstruction shall be 24” maximum.
4. Section 404.2.9: Fire doors shall have a minimum opening force allowable by the applicable Building Code. The force for pushing or pulling open a door other than fire doors shall be 5 pounds maximum.

E. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

F. Provide in accordance with rules and regulations of the following:

1. Building Codes enforced by the Authority Having Jurisdiction in California:

    a. 2013 Building Standards Administrative Code, Part 1, Title 24 California Code of Regulations (CCR).
    b. 2013 California Building Code (CBC), Part 2, Title 24 CCR (2012 International Building Code with California Amendments)
    c. 2013 California Electrical Code (CEC), Part 3, Title 24 CCR (2011 National Electrical Code with California Amendments)
    d. 2013 California Mechanical Code (CMC) Part 4, Title 24 CCR 2012 Uniform Mechanical Code with California Amendments)
    e. 2013 California Plumbing Code (CPC), Part 5, Title 24 CCR (2012 Uniform Plumbing Code with California Amendments)
    f. 2013 California Energy Code (CEC), Part 6, Title 24 CCR
    g. 2013 California Fire Code, Part 9, Title 24 CCR (2012 International Fire Code with California Amendments
    h. 2013 California Green building Standards Code (CALGreen), Part 11, Title 24 CCR.
    i. 2013 California Referenced Standards, Part 12, Title 24 CCR.
    j. Title 19 CCR Public Safety, State Fire Marshal Regulations.

2. Local, city, county and state codes and ordinances
3. Local Bureau of Buildings
4. Local Health Department
5. Local and State Fire Prevention Districts
6. State Administrative Codes

G. Provide in accordance with appropriate referenced standards of the following:

1. NFPA - National Fire Protection Association
2. AABC - Associated Air Balance Council
3. CSA - Canadian Standards Association
4. ADC - Air Diffuser Council
5. AMCA - Air Moving and Conditioning Association
6. ANSI - American National Standards Institute
7. ARI - Air Conditioning and Refrigeration Institute
8. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
9. ASME - American Society of Mechanical Engineers
10. ASTM - American Society for Testing Materials
11. AWS - American Welding Society
12. FM - Factory Mutual
13. MSS - Manufacturer's Standardization Society
14. NEMA - National Electrical Manufacturer's Association
15. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
16. UL - Underwriter's Laboratories
17. ADA - Americans with Disabilities Act
18. ETL - Electrical Testing Laboratories

1.8 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be metallic riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data suitable for the ambient exposure.

B. All work shall include the following:

1. Manufactured items and equipment shall be a current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

C. Experience: Unless more stringent requirements are specified in other sections of Division 23, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

D. Each product and/or equipment type shall be provided by one manufacturer. Mixtures of manufacturers for each product and/or equipment type are not acceptable. Example – all fire dampers shall be supplied by one manufacturer.

E. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner’s Representative.

1.9 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Prepare a Construction IAQ Management Plan meeting the SMACNA IAQ guidelines. See Section 233113 Air Distribution for a summary of requirements.

E. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access.

F. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications for rough-in requirements.

G. Coordinate mechanical equipment and materials installation with other building components.

H. Verify all dimensions by field measurements.

I. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

J. 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.

K. 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.

L. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor shall provide for all cutting and patching required for installation of this work unless otherwise noted.

M. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

N. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

O. Coordinate the installation of mechanical materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations.

P. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

Q. Coordinate with Owner's Representative in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

R. All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

S. Coordinate installation of floor drains and floor sinks with work of other trades, such that finished floor slopes to drains and floor sinks are flush with surrounding floor.

T. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

1.10 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all mechanical work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this Section.

B. The Contractor shall review the structural and architectural conditions affecting their work. It is the specific intention of this section that the contractor's scope of work shall include:

1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications
2. Minor deviations from the mechanical plans required by architectural and structural coordination.

C. The Contractor shall study the operational requirements of each system, and shall arrange work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work". Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

D. Minor deviations in order to avoid conflict shall be permitted where the design intent is not altered.

E. Advise the Owner's Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

1.11 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Owner's Representative for approval.

C. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

D. Submittals and Shop Drawings:

1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per Division. Multiple submissions will not be accepted without prior approval of the Owner's Representative. Organize submittal sheets in sequential order aligned with matching specification section numbers.
2. Provide electronic copies of shop drawings prepared to show details of the proposed installation. Copies of contract design drawings submitted to demonstrate shop drawing compliance will not be accepted.
3. Paper submittals will only be acceptable if specifically required by Division 01.
4. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.

1.12 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings using the same electronic format as the contract documents.

1. The shop drawings shall serve to record the coordination of the installation and location of all HVAC equipment, ductwork, grilles, diffusers, piping, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances.
2. The Drawings shall include all mechanical rooms and floor plans.
3. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Owner's Representative and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide maintenance access

clearance as required by manufacturer installation instructions and as required to meet minimum code clearances. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor and Owner's Representative.

4. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings or electronic coordination should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The coordination work shall be prepared as follows:

1. Two dimensional AutoCAD / Revit based documents:

   a. Contractor shall prepare AutoCAD/Revit coordination drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate locations, sizes and elevations above finished floor, of all systems. Lettering shall be minimum 1/8" high.
   b. Contractor shall obtain AutoCAD/Revit drawings from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the HVAC work.
   c. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
   d. Drawings shall incorporate all addenda items and change orders.
   e. Distribute drawings to all other trades and provide additional coordination as needed to assure adequate space for piping, equipment and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

2. Three dimensional Revit / BIM based documents (if required for project):

   a. Provide three dimensional Revit model and BIM input information locating all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
   b. Contractor shall obtain Revit model and BIM input from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.
   c. Model shall indicate locations of all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
   d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
   e. Model shall incorporate all addenda items and change orders.
   f. Distribute Revit model and BIM input information to all other trades and provide additional coordination as needed to assure adequate space for equipment and piping and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

C. Advise the Owner’s Representative in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner’s Representative of conflict.

D. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Owner’s Representative of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

E. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

F. Provide copy of Record Drawings to Testing and Balancing Contractor for their use when doing their work.

1.13 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 01).

1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
2. RFIs shall address single questions and related issues only.
3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to the Owner’s Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect and/or Construction Manager.
6. RFI number, numbered sequentially and unique.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer’s Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional

time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Incomplete RFIs or inaccurately prepared RFIs.
    b. RFIs submitted without indication of review and approval for submission by General Contractor or Construction Manager.
    c. RFIs addressing multiple unrelated issues.
    d. Requests for approval of submittals.
    e. Requests for approval of substitutions.
    f. Requests for approval of Contractor's means and methods.
    g. Requests for information already indicated in the Contract Documents.
    h. Requests for adjustments in the Contract Time or the Contract Sum.
    i. Requests for interpretation of Engineer's actions on submittals.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.14 RECORD DOCUMENTS

A. Maintain set of Coordination Documents (drawings and specifications) marked “Record Set” at the job site at all times, and use it for no other purpose but to record on it all the changes and revisions during construction.

B. Record Drawings shall 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; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.).

C. Record Specifications shall indicate approved substitutions; Change Orders; and actual equipment and materials provided.

D. Provide copy of Record Documents to Testing and Balancing Contractor and Commissioning Agent for use when performing their work.

E. At the completion of the construction transfer all “Record Set” notations to a clean set of drawings and specifications in a neat and orderly fashion that incorporates all site markups to clearly show all changes and revisions to the Contract Documents. Submit copies of Record Documents and CD/DVD disks labeled with all drawings and specifications and other supporting documentation.

F. Refer also to Division 01 for full scope of requirements.

1.15 START-UP SERVICE AND BUILDING COMMISSIONING

A. Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of air conditioning units, temperature controls, chillers, boilers, pumps, and other major pieces of equipment. Certify in writing

compliance with this Paragraph, stating names of personnel involved and the date work was performed.

C. Provide certificates of calibration for all sensors required for control and monitoring including temperature and pressure.

D. Refer to other Division 23 Sections for additional requirements.

1.16 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Upon completion of the work, and prior to training of Owner's personnel, the Contractor shall submit to the Owner's Representative complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 01.

B. Contractor shall be responsible for providing proper instruction of the of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 23. Training is to be appropriate to the complexity of the equipment. The Contractor shall develop and submit training materials prior to this training. These materials shall include qualifications of the trainer, training agenda, learning objectives, and a written test to be administered at the end of the training session. Operation and Maintenance manuals must present, incorporated and referenced in the training sessions.

1.17 DELIVERY, STORAGE AND HANDLING

A. 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.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping and equipment showing signs of rust shall be removed from site and replaced with new.

1.18 UNIT PRICING SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. Preliminary List of Materials and Unit Price Items: Within thirty (30) days after awarding of the Contract, submit to Owner's Representative for preliminary approval a complete list of manufacturer's names and model numbers of proposed materials and equipment. Also include proposed list of unit price items for review.

1. Indicate substituted items.
2. Identify test and balancing agency.
3. Identify independent testing laboratory for water analysis.

C. The Contractor shall submit with preliminary list of materials a unit price list for each item furnished on this project. Included with price shall be labor cost index.

D. Submittals and Shop Drawings shall be submitted as a complete package bound in a 3-ring binder with tabs for each specification section. Submit six (6) typed copies of submittals. Refer to Division 01 for additional requirements.

1.19 TEMPORARY FACILITIES

A. Refer to Division 01 for the requirements of temporary water and sewer for construction and safety. Provide temporary heating, air conditioning, ventilation, water, and sewer, etc. services as necessary during the construction period and as required to maintain operation of existing systems.

B. Temporary Heating for Commissioning Tests:

1. Provide temporary heating where needed to provide false load for commissioning tests.
2. Temporary heating may be from the permanent heating system of the project or from a dedicated temporary heating system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon what work in place or being installed.

C. Temporary Cooling for Commissioning Tests:

1. Provide temporary cooling where needed to provide false load for commissioning tests.
2. Temporary cooling may be from the permanent cooling system of the project or from a dedicated temporary cooling system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon the work in place or being installed.

1.20 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.21 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, Drawing, review, or Construction Review by the Owner’s Representative, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner’s Representative, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.22 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner's Representative.

1.23 WARRANTIES

A. Refer to general terms and conditions, as well as warranties and obligations defined in Division 1 of the specifications that provide basic warranty requirements for the entire project.

B. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

C. All equipment and systems shall be provided with a minimum one-year warranty, defined as starting from the date of Certificate of Occupancy and shall include all parts, material, labor and travel.

D. Refer to individual Specification sections for additional extended warranty requirements, defined as starting from the date of Certificate of Occupancy and shall include all parts, material, labor and travel.

E. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

F. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

G. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.24 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year, minimum, after the Certificate of Occupancy, ordinary wear and tear excepted.

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in this work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words “or approved equal” shall be considered to be subsequent to all manufacturers’ names used herein, unless specifically noted that substitutes are not allowed.

2.2 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:

1. UL and FM Compliance: Provide products, which are UL listed and FM approved.
2. ASCE 7-05: “American Society of Civil Engineers.”
3. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).
4. SMACNA: “Seismic Restraint Manual: Guidelines for Mechanical Systems.”
5. NFPA: Pamphlet number 13 and 14 for fire protection systems.
6. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.
7. Manufacturer: Hilti Inc., B-Line, Anvil International, Erico, Tolco, Kin-Line, Simpson Strong-Tie Co. Inc., Superstrut, or Powers Fasteners.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.

1. Adjustable Steel Clevis Hangers: MSS Type 1.
2. Adjustable Steel Swivel Band Hangers: MSS Type 10.
3. U-Bolts: MSS Type 24.
4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

    a. Plate: Unguided type.
    b. Plate: Guided type.
    c. Plate: Hold-down clamp type.

5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.
6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.
7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.
8. Single Pipe Roller with Malleable Sockets: MSS Type 41.
9. Adjustable Roller Hangers: MSS Type 43.
10. Pipe Roll Stands: MSS Type 44.
11. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a 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.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.

1. Steel Turnbuckles: MSS Type 13.
2. Steel Clevises: MSS Type 14.
3. Swivel Turnbuckles: MSS Type 15.
4. Malleable Iron Eye Sockets: MSS Type 16.
5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated by the Structural Engineering design, provide factory-fabricated building attachments of one of the following types listed.

1. Concrete Inserts: HCI-MD (for metal deck) or HCI-WF (for wood forms) cast-in anchors by Hilti Inc. or MSS Type 18, Blue Banger Hanger by Simpson Strong-Tie Co. Inc., or Bang-It (for metal deck) or Wood-Knocker (for wood forms) by Powers Fasteners.
2. Steel Brackets: One of the following for indicated loading:

    a. Light Duty: MSS Type 31.
    b. Medium Duty: MSS Type 32.
    c. Heavy Duty: MSS Type 33.

3. Horizontal Travelers: MSS Type 58.
4. Concrete Screw Anchors: KWIK HUS EZ-I by Hilti Inc., Titen HD (or Rod Hanger version) by Simpson Strong-Tie Co. Inc., Wedge-Bolt+ (Screw Anchor) by Powers Fasteners, or Vertigo+ (Rod Hanger) by Powers Fasteners, or Snake+ (Internally Threaded Screw Anchor) by Powers Fasteners, or equal.
5. Torque-Controlled Expansion Anchor: KWIK BOLT-TZ by Hilti Inc., Strong-Bolt 2 by Simpson Strong-Tit Co. Inc., Power-Stud+ SD1 and Power-Stud+ SD2 by Powers Fasteners, or equal.

G. Saddles and Shields: 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.

1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
2. Insulation Protection Shields: MSS Type 40, 18" minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.
3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert. Alternately Polyisocyanurate Urethane with a minimum flexural strength of 60psi, fully encased in 360 PVC (1.524 mm thick) SNAPPITZ. Provide assembly of same thickness as adjoining insulation.

4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:

1. Metal Framing: Provide products complying with NEMA STD ML1.
2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.
3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of one part cement to three 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 Brackets: “HoldRite” copper plated brackets. Insulate brackets attached to metal studs with felt.

2.3 PIPE PORTALS

A. Where pipe portals are not provided by other sections of Specification, provide prefabricated insulated pipe portals as required for piping penetrating through the roof where shown on plans. Field built pipe portals are acceptable alternatives - provide detail of construction for review.

B. Standard pipe portals, unless otherwise noted, shall be constructed as follows:

1. Curb shall be constructed of heavy gauge galvanized steel with continuous welds on shell seams.
2. Insulation to be 1-1/2" thick, 3 lb density rigid fiberglass.
3. Curb to have a raised 3" (minimum), 45° cant.
4. Curb to have 1-1/2" x 1-1/2" wood nailer (minimum).
5. Curb height to be 8" (minimum) above roof deck.
6. Cant shall be raised to match roof insulation thickness.
7. Cover or flashing to be constructed of galvanized steel or other suitable material to provide sturdy weather tight closure. Provide collars and rubber nipples with draw bands of sizes required by piping. Size curb, cover and nipples per manufacturer's recommendations.

C. Manufacturer: Roof Products Systems, Pate, or equal.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping. Coordinate all pipe stands with structural design.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

2. Base: Plastic or stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

G. Manufacturer: Pate, Roof Products Systems, Portable Pipe Hangers, Roof Top Blox, Erico Caddy Pyramid, or equal.

2.5 EQUIPMENT/PIPING RAILS

A. Where equipment/pipe rails are not provided by other sections of Specification, provide prefabricated reinforced equipment rails as required for support of equipment and piping. Field built curbs are acceptable alternatives - provide detail of construction for review.

B. Standard equipment rail, unless otherwise noted, shall be constructed as follows:

1. Construct of heavy gauge galvanized steel with continuous welds on shell seams.
2. Provide internal reinforcing supports welded as required to meet application requirements.
3. Equipment rails to have raised 3" (minimum), 45° cant.
4. Equipment rails to have 1 1/2" x 1 1/2" wood nailer (minimum) and counterflashing.
5. Equipment rail height to be 6" (minimum) above roof deck.
6. Cant shall be raised to match roof insulation thickness.

C. Equipment rails to be constructed to meet equipment size and weight requirements. Provide tapered rails to match roof pitch where required.

D. Manufacturer: Pate, Vent Products, Thy Curb, Roof Products Systems, or equal.

2.6 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20-gauge steel, 1" flange width, continuous piano hinge, key operated, prime coated. Refer to Division 01 Architectural specifications and drawings for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels are not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each trap primer or concealed valve, for fire and combination fire/smoke dampers, and for volume dampers. Use no panel smaller than 12" x 12"

for simple manual access, or smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Owner's Representative. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Owner's Representative.

D. Manufacturers: Milcor, Karp, Nystrom, Elmdor/Stoneman, or equal.

2.7 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide products of categories and types required for each application as referenced in other Division 23 Sections. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category. Stencils, hand printed, painted, and felt pen markers are not acceptable.

B. Plastic Pipe Markers:

1. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially or fully cover the circumference of pipe, or insulated pipe, and to attach to pipe without fasteners or adhesive complying with ANSI A13.1. Minimum letter size shall be 1/2" high.
2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape.
3. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
4. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
5. Nomenclature shall include service type and directional arrow as follows:

    a. Chilled Water Supply and Return: green background with white lettering.
    b. Heating Water Supply and Return: yellow background with black lettering.
    c. Condenser Water Supply and Return: green background with white lettering.
    d. Heat Pump Loop Supply and Return: green background with white lettering.
    e. Refrigerant: yellow background with black lettering.
    f. Exhaust air: blue background with white lettering.
    g. Other piping services: Comply with ANSI and ASME A13.1standards.
    h. Direction of water flow.

C. Plastic Duct Markers:

1. Provide duct labels to indicate the system and direction of flow. Submit a labeling product that is suitable for the surface to be labeled.

    a. Pressure sensitive, 16" long by 2-1/4" high (minimum), 3 mil thick high gloss adhesive backed vinyl, 1-1/2" high letters, and color coded per ducted service.

2. Nomenclature shall include service type and directional arrow as follows:

a. Supply air (cold service): green background with white lettering.
b. Supply air (hot service): yellow background with black lettering.
c. Return air: blue background with white lettering.
d. Relief air: blue background with white lettering.
e. Outside air: blue background with white lettering.
f. Exhaust air: blue background with white lettering.
g. Other air services: Comply with ANSI and ASME A13.1standards.
h. Direction of air flow.

D. Valve Tags:

1. Brass Valve Tags: Provide 1-1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Fill tag engraving with black enamel.
2. Plastic Laminate Valve Tags (indoors only): Provide 3/32” thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32” hole for fasteners.
3. Valve Tag Fasteners: Provide 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.

E. Access Panel Markers: Provide 1/16" thick (minimum) engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or device.

F. Plastic Equipment Signs:

1. Provide 4-1/2” x 6” (minimum) plastic laminate sign, ANSI A.13 color coded with engraved white core lettering. Minimum letter size shall be 1/2” high.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
3. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

    a. Tag number
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters, such as pressure drop, entering and leaving conditions, rpm, etc.

4. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2”x11” bond paper, tabulate each equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

G. Underground-Type Plastic Line Markers: Provide 6" wide x 4 mils thick multi-ply tape, consisting of solid metallic foil core between 2 layers of plastic tape. Markers to be permanent, bright colored, continuous printed, intended for direct burial service.

H. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Inc., or Brimar.

2.8 ELECTRICAL

A. General:

1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.
2. Provide all motors for equipment specified herein. Provide motor starters, controllers, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.
3. Set and align all motors and drives in equipment specified herein.
4. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.
5. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted "U" cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.
6. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

B. Quality Assurance:

1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Motors:

1. 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.
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. Unless otherwise noted on plans, all motors 1/2 HP or larger shall be rated for 208 or 460 volt, 3-phase, operation. Unless otherwise noted on plans, all motors less than 1/2 HP shall be rated for 120 volt, single phase operation.
4. Temperature Rating: Motor meets class B rise with class F insulation.
5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
6. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

    a. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.
    b. VFD driven motors to be provided as inverter ready and equipped with a shaft grounding device, or inverter duty complying with NEMA Standard MG-1, Part 31 as supplied by same manufacturer as VFD.
    c. Bearings:
        1) Ball or roller bearings with inner and outer shaft seals.
        2) Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
        3) Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.
        4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.

5) Enclosure Type:
   a) Open drip-proof (ODP) motors for indoor use in clean air environments.
   b) Totally enclosed fan cooled (TEFC) motors for outdoor use and indoor application in dirty environments.
   c) Totally enclosed air over (TEAO) motors for motors in the airstream of cooling towers and fluid coolers.
   d) Guarded drip-proof motors where exposed to contact by employees or building occupants.
   e) Weather protected Type I for outdoor use, Type II where not housed.

d. Overload Protection: Built-in thermal overload protection where external overload protection is not provided and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
e. Noise Rating: "Quiet."
f. Efficiency:
   1) Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.
   2) And, motors shall meet the NEMA premium efficiency standard.

g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

D. Starters and Electrical Devices:

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.
   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 pilot lights and all required switch positions for multi-speed motors. Overload Protection: Melting alloy or bi-metallic type thermal overload relays, sized according to actual operating current (field measured).
3. Magnetic Starters:

   a. Heavy duty, oil resistant, hand-off-auto (HOA), or as indicated, and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
   b. Trip-free thermal overload relays, each phase, sized according to actual operating current (field measured).
   c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
   d. Built-in primary and secondary fused control circuit transformer, supplied from load side of equipment disconnect.
   e. Externally operated manual reset.
   f. Under-voltage release or protection for all motors over 20 hp.

4. Motor Connections: Liquid tight, flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Low Voltage Control Wiring:

1. General: 14-gauge, Type THHN, color coded, installed in conduit.
2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., or Southwire Co.

F. Disconnect Switches:

1. Fusible Switches: For equipment 1/2 HP or larger, provide fused, each phase; heavy duty; horsepower rated; spring loaded 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.
2. Non-Fusible Switches: For equipment less than 1/2 horsepower, switch shall be horsepower rated; toggle switch type with thermal overload quantity of poles and voltage rating as required.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work unless so indicated on Drawings or approved by Owner’s Representative.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

1. If the contractor must deviate from the manufacturer’s recommendations provide a letter from the manufacturer indicating the clearance to be provided is acceptable for scheduled performance and maintenance.

3.3 INSTALLATION

A. Coordinate the work between the various Mechanical Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision or failure to make proper and timely provisions, the alternations shall be made to the satisfaction of the Engineer and at the Contractor’s cost. Coordinate wall and ceiling work with the General Contractor, and other trades in locating ceiling air outlets, wall registers, etc.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defected materials.

3.4 SUPPORTS AND HANGERS

A. 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 with requirements specified.

B. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for 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 Gypcrete is indicated, install reinforcing bars through opening at top of inserts.

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. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. 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.

E. Install hangers within 12 inches of every change in piping direction, end of pipe run or concentrated load, and within 36 inches of every major piece of equipment. Hangers shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one hanger is required.

F. 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.

G. Support sprinkler piping and gas independently of other piping.

H. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

I. Hanger Spacing in accordance with following minimum spans for support of individual pipes and a minimum of one hanger per elbow at each change of direction. Other spacing and rod sizes may be considered in compliance with Table 121.5 of ASME B31.1, but shall not exceed 20 feet for large size pipe

1. Steel Pipe (Water Filled):

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2” to 1”	7 feet	3/8”
1-1/4” to 2”	10 feet	3/8”
3” to 4”	12 feet	3/8”
5” to 8”	15 feet	1/2”
10” to 12”	20 feet	2@5/8”
14” to 16”	20 feet	2@3/4”

2. Steel Pipe (Gas/Air Filled):

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2" to 1-1/4"	6 feet	3/8"
1-1/2" and larger	10 feet	1/2"

3. Copper Pipe:

Pipe Size	Max. Hanger/Support Spacing	Rod Size

1/2" to 2"	6 feet	3/8"
2-1/2" and larger	8 feet	1/2"

4. Glass Pipe:

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2" to 2"	6 feet	3/8"
2-1/2" and larger	8 feet	1/2"

5. Plastic/Fiberglass Pipe:

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2" to 2"	4 feet	3/8"
2-1/2" and larger	6 feet	1/2"

6. Caulked Bell and Spigot and Glass Pipe: Provide hanger for each section of pipe, located at shoulder of bell. Where an excessive number of fittings are installed between hangers, provide additional reinforcing.
7. Trapeze support: Provide details stamped by a Registered Structural Engineer for the project state indicating trapeze channels, support rod sizes, and spacing.

J. Provisions for Movement:

1. 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.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.
3. Insulated Piping: Comply with the following installation requirements:

    a. Clamps: Attach clamps, including spacers, (if any), to piping with clamps projecting through insulation.
    b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install shields or inserts.
    c. Saddles: Where insulation without vapor barrier is indicated install protection saddles.

K. Installation of Anchors:

1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.
3. 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.
4. 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.

L. Equipment Supports:

1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction.

2. 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.

M. Adjusting:

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. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 WALL, FLOOR, AND ROOF PENETRATION SIZING

A. All pipe penetrations through rated and non-rated assemblies shall be sized to allow for compliance with structural integrity and fire ratings, as applicable. Where sleeves are required, the sleeve size shall be installed with the inside clear diameter providing clearances as required below. Coordinate the required opening sizes with the manufacturer of the fire protection products.

1. Uninsulated pipe penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each uninsulated pipe.
2. Insulated pipes penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each pipe, including insulation.
3. Uninsulated pipe penetrations through fire rated walls and floors, and through roof: penetration sizes shall be a 1/2” (minimum) to 1-1/2” (maximum) larger than the outside diameter of each uninsulated pipe to provide minimum 1/4” annular space between the outside of the pipe surface and assembly. Coordinate with specific manufacturer requirements and UL listing.
4. Insulated pipe penetrations through fire rated walls and floors, and through roof: pipe penetration sizes shall be a 1/2” (minimum) to 1-1/2” (maximum) larger than the outside diameter of each insulated pipe to provide minimum 1/4” annular space between the outside of the insulation surface and assembly. Coordinate with specific manufacturer requirements and UL listing.
5. Uninsulated pipe penetrations through foundation and basement walls: penetration sizes shall be larger than the outside diameter of each uninsulated pipe to allow adequate space for installation of mechanical link seals. Coordinate with specific manufacturer requirements.

3.6 ELECTRICAL COORDINATION

A. Division 23 installers shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the drawings and in accordance with equipment manufacturer’s written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA’s “Standard of Installation” to ensure that products fulfill requirements.

C. Division 23 has responsibilities for electrically powered mechanical equipment which is specified in Division 23 Specifications or scheduled on Division 23 Drawings as follows:

1. Motors: Furnish and install all motors necessary for mechanical equipment.
2. Magnetic Starters: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 23 equipment, also furnish and install the power wiring between starter and motor.
3. Variable Frequency Drives: Provide all VFD's associated with mechanical equipment. If the drive is installed on a piece of factory assembled equipment the wiring between motor and drive is to be provided as part of the factory equipment.
4. Disconnects: Provide the disconnects which are part of factory wired Division 23 equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.
5. Controls: Division 23 Contractor (including the Building Automation System (BAS) Controls subcontractor) is responsible for furnishing the following equipment in its entirety. This equipment includes but is not limited to the following:

    a. Control relays necessary for controlling Division 23 equipment.
    b. Control transformers necessary for providing power to controls for Division 23 equipment.
    c. Line voltage thermostats.
    d. Low or non-load voltage control components.
    e. Remote bulb thermostats.
    f. Non-life safety related valve or damper actuators.
    g. Float switches.
    h. Solenoid valves, EP and PE switches.
    i. Refrigeration controls.
    j. Communications wiring and conduit between control devices and mechanical equipment.
    k. Raceway to support control cabling.

6. Fire/Smoke Dampers: Division 23 is responsible for providing and physically installing the damper and for installing any required control interface wiring to Division 23 controls.

    a. Where fire/smoke dampers are part of an integrated smoke control system, Division 23 is responsible for providing dampers with necessary end switches for use by Division 28 in providing proof of closure.
    b. Where these dampers are not part of an integrated area wide smoke detection system, Division 23 is responsible for providing each fire/smoke damper with a dedicated duct detector installed per the requirements of the building code. If not integral with the damper assembly, the detector is to be installed in ductwork by Division 23 but wired to the damper controller by Division 26.

D. Division 26 Electrical Responsibilities:

1. Motors: Provide the power wiring for the motors from servicing panel to motor controller.
2. Magnetic Starters: Except where magnetic starters are factory installed on Division 23 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 23 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring from source panel/disconnect to the starter.

3. Variable Frequency Drives: Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's where wiring between the motor and VFD is to be by Division 23.
4. Disconnects: Provide all disconnects necessary for Division 23 mechanical equipment which are not provided as part of factory wired Division 23 equipment. Provide power wiring to all disconnects. In addition provide power wiring between motor and disconnect when the disconnect is not factory installed.
5. Controls: Division 26 is responsible for providing power to mechanical control panels and provide final power connection to Division 23 provided control transformers.
6. Fire/Smoke Dampers: Division 26 is responsible for power wiring to each damper and as follows:

    a. Where these dampers are part of an integrated smoke control system Division 28 is responsible for providing the detectors and for all fire/smoke detection system wiring necessary to integrate dampers and related end switches into the system.
    b. Where these dampers are not part of an integrated area wide smoke detection system, Division 23 is responsible for providing each fire/smoke damper with a dedicated duct smoke detector installed per the requirements of the building code. If not integral with the damper assembly, the detector is to be installed by Division 23, but wired for damper control by Division 26.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.7 PAINTING

A. All painting shall be provided under this Division work, unless otherwise specified under Section 099100: Painting. Painting schemes shall comply with ANSI A13.1. Paint all exposed materials such as piping, ductwork, equipment, insulation, steel, etc. The inside surface of visible ductwork above diffusers/grilles shall be painted flat black.

B. All exposed work under Division 23 shall receive either a factory finish or a field prime coat finish, except:

1. Exposed copper piping.
2. Aluminum jacketed outdoor insulated piping.

3.8 IDENTIFICATION MARKERS

A. General: 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. Piping System Identification:

1. Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.
2. Locate pipe markers as follows:

a. Near each valve and control device.
b. 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.
c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
d. At access doors, manholes, and similar access points which permit view of concealed piping.
e. Near major equipment items and other points of origination and termination.
f. Spaced horizontally at maximum spacing of 30' along each piping run, with minimum of one in each room.
g. Vertically spaced at each story transversed.

C. Ductwork Identification: A minimum of every 50' for all ductwork 12" or more in diameter or width.

D. Mechanical Equipment Identification: Locate engraved plastic laminate signs on or near each major item of mechanical equipment and each operational device. Provide signs for the following:

1. Main control and operating valves, including safety devices.
2. Meters, gauges, thermometers, and similar units.
3. Pumps, compressors, chillers, and similar motor-driven units.
4. Hot water system mixing valves and similar equipment.
5. Boilers, heat exchangers and similar equipment.
6. Fans, blowers, primary balancing dampers, and mixing boxes.
7. Packaged HVAC central-station and zone-type units.
8. Tanks and pressure vessels.
9. Strainers, filters, treatment systems and similar equipment.

E. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.

F. Underground Piping Identification: During backfilling/topsoiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker.

3.9 VIBRATION AND DYNAMIC BALANCING

A. All equipment submitted and installed by Division 23 shall not exceed maximum tolerances as specified by the “International Research and Development Corporation”, Worthington, Ohio, measured by the displacement, peak to peak, as follows:

1. All Fans: Below severity chart labeled “FAIR”, maximum velocity of 0.0786 in/sec, peak.

2. Pump and Electric Motors: Below severity chart labeled “SLIGHTLY ROUGH”, maximum vibration velocity of 0.157 in/sec, peak.
3. Compressors: Same as pumps.

B. Where installed equipment noise or vibration is objectionable to the Owner’s Representative, it shall be responsibility of the contractor to conduct testing to confirm that the equipment does not exceed the standard.

C. Correction shall be made to all equipment, which exceeds vibration tolerances specified above. Final vibration levels shall be reported as described above.

3.10 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner’s Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Ductwork: Test all air quantities as specified in Section 230593 - Testing, Adjusting and Balancing. Pressure tests per SMACNA.

C. Registers and Diffusers: Test for proper operation of manually operated control feature. Test all air quantities as specified in Section 230593 – Testing, Adjusting and Balancing.

D. Ductwork Specialties: Test all operable ductwork specialties for proper operation. Check all fire, smoke and fire/smoke dampers to ensure that they are 100% open.

E. Temperature Control: Test all control functions to assure that all systems are controlling as specified or as otherwise necessary and that all controls are adjusted to maintain proper room temperatures. The manufacturer's representative shall perform all tests.

END OF SECTION 230500

SECTION 23 05 48

VIBRATION ISOLATION FOR PIPING, DUCTWORK, AND EQUIPMENT

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SUMMARY

A. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure.

B. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.

C. All mechanical equipment, piping and ductwork as noted on the equipment schedule, in the specification or as required by code shall be designed to resist seismic forces. Refer to Section 230549 Seismic Restraint for Piping, Ductwork and Equipment

D. This Section includes the following:

1. Vibration isolation curbs, pads and mounts.
2. Flexible ductwork connectors
3. Spring hangers with and without vertical-limit stops.
4. Spring isolators.
5. Restrained uni-directional seismic isolation snubber mounts.
6. Housed seismic spring vibration mounts.
7. Elastomeric hangers.
8. Pipe riser resilient supports.
9. Resilient pipe guides.
10. Air-mounting system.
11. Restrained vibration isolation roof-curb rails.
12. Seismic snubbers.
13. Vibration isolation equipment bases.
14. Flexible piping connectors

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic HVAC Materials and Methods

B. Section 230549: Seismic Restraint for Piping, Ductwork and Equipment

1.4 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. IBC: International Building Code with State Amendments.

C. ICC-ES: ICC-Evaluation Service.

1.5 CODES AND STANDARDS

A. Provide components conforming to the load requirements of the latest addition of the local building code and the following:

1. 2012 International Building Code with AHJ Amendments
2. American Society of Civil Engineers (ASCE):

    a. ASCE 7-10: Minimum Design Loads for Buildings and Other Structures

3. The Manufacturers Standardization Society (MSS):

    a. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
    b. MSS SP-69: Pipe Hangers and Supports - Selection and Application.
    c. MSS SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices
    d. MSS SP-127: Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.

4. Mason West Inc. Seismic Restraint Guidelines 2014 Edition

    a. For all suspended piping, suspended ductwork and suspended electrical raceways.

1.6 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Seismic forces for new installations are determined per ASCE/SEI 7-05. Refer to Structural Design for seismic factors and design criteria. Select and submit appropriate values for each piece of equipment and sub-system and material type for the project, and base the seismic calculations on these values.
2. Refer to Section 230549 Seismic Restraint for Piping, Ductwork and Equipment for seismic specific requirements.
3. Coordinate all seismic and load requirements with the registered professional Structural Engineer.

B. Component Importance Factor:

1. Ip=1.0: Standard Occupancies and components associated with Risk Category I, II, and III, including offices and schools.
2. Ip=1.5: Components associated with Risk Category IV Buildings (Essential Services); or for conditions outlined in ASCE 7-10 Section 13.1.3 regardless of Risk Category; or

Hospitals and Correctional Treatment Centers. Components include, but are not limited to the following:

a. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems.
b. The component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established y the authority having jurisdiction and is sufficient to pose a threat to the public if released.

1.7 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Building Structural Limits: The design of supports and restraints shall not exceed the building structure allowable point loads. Coordinate all work with the registered professional Structural Engineer.

D. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

1.8 WARRANTY

A. Refer to section 230500 for basic warranty requirements.

1.9

1.10 SUBMITTALS

A. Product Data shall include the following:

1. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
2. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
3. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
4. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service or agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
2. Provide all details of suspension and support for ceiling hung equipment.
3. Where walls, floors, slabs or supplementary steel work are used for seismic restraint the 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.
4. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and where required wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads. Provide base with level top surfaces with integral sloping on bottom to match support structure.

D. Coordination Drawings: Show coordination and plan locations of vibration isolation for HVAC ductwork, piping, and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

E. Qualification Data: Devices shall be selected to meet seismic and support requirements by a registered professional Structural Engineer.

F. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent test agency.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.11 WARRANTY

A. Refer to section 230500 for basic warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS AND APPLICATION

A. Factory Finishes:

1. Standard paint applied to factory-assembled equipment before shipping.
2. Powder coating on springs and housings.
3. All hardware shall be galvanized or powder coated.
4. Hot-dip galvanized or powder coating of metal components for exterior use.
5. Baked enamel or powder coat for metal components for interior use.

B. Glumac Device Key Schedule: Part 3 of this Section schedules the application of devices described in Part 2 for use with mechanical equipment found on this project. The tag designation of preferred devices is as follows:

Glumac Isolator Tag	Description
P-1	Vibration isolation waffle pad
P-2	Double deflection neoprene mount
P-3	Uni-directional restrained neoprene snubber mount
P-4	Interlocking uni-directional snubber
S-1	Open spring vibration isolator
S-2	Steel housed seismic spring vibration isolator
S-3	Bellows air spring isolator
S-4	Restrained air spring isolator
C-1	Seismic spring isolation roof curb (20 ton HVAC and below)
C-2	Seismic spring isolation roof curb (Greater than 20 ton HVAC)
C-3	Curb mounted spring isolation roof base
B-1	Integral equipment and motor base
B-2	Integral equipment and motor base
B-3	Concrete filled steel inertia base
H-1	Spring and rubber in shear vibration isolation hanger
G-1	All-directional pipe anchor
G-2	Vertical pipe guide
G-3	Horizontal thrust restraint
SB-1	Sway bracing
F-1	Kevlar/rubber spherical type flexible piping coupling
F-2	Stainless hose flexible piping coupling
F-3	Flexible expansion joints
F-4	Flexible ductwork connector

2.2 VIBRATION ISOLATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

1. Mason, basis of selection or equal by

2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Kinetics Noise Control.
5. Vibration Eliminator Co., Inc.
6. Vibration Isolation.
7. Vibration Mountings & Controls, Inc
8. Vibro-Acoustics, Inc
9. Vibrex

B. P-1 Style: Neoprene pads shall consist of a 3/4" (19 mm) thick neoprene pad molded in square waffle modules, a minimum 1/4" (6 mm) thick steel load distribution plate and 3/4" (19 mm) hole with a neoprene anchor bolt bushing with a flat washer face. Pads may be single or multiple layers as required for leveling. Pads shall be Mason #MBSW Series or equal.

C. P-2 Style: Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" (5mm) and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall be Mason #BR Series or equal.

D. P-3 Style: 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" (6 mm) thick. A minimum air gap of 1/8" (3 mm) shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. No sharp edges such as bolt threads may come in contact with the neoprene bushing. Snubber end caps shall be removable to allow inspection of internal clearances. Snubber shall be Mason #Z-1225 Series or equal.

E. P-4 Style: 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" (19 mm) thick. Rated loadings shall not exceed 1000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" (3 mm) nor more that 1/4" (6 mm). Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" (9 mm) 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" (12 mm) deflection in the x, y and z planes. Snubbers shall be Mason #Z-1011 Series or equal.

F. S-1 Style: Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" (6 mm) neoprene acoustical friction pad between the base plate 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. Two base plate holes for attachment to support surface. Isolators shall be Mason #SLFH Series or equal.

G. S-2 Style: Restrained spring mountings shall include springs that are free standing and laterally stable and complete with a molded neoprene cup or 1/4" (6 mm) neoprene acoustical friction

pad between the spring and the mounting base plate. All spring assemblies shall have leveling bolts. 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. Mount housing shall include vertical limit stops to prevent spring extension when weight is removed. All restraining bolts shall have large rubber grommets to provide cushioning in the vertical and horizontal directions. A minimum clearance of 3/8" (9 m) shall be maintained around restraining bolts so as not to interfere with the spring action. Mountings shall be Mason #SLR Series or #SLRS Series for steel/wood connections and Mason #SLREBP Series or #SLRSEBP Series or #SSLFH Series for concrete connections, or equal.

H. S-3 Style: Multiple bellow air springs shall be manufactured with powder coated upper and lower steel sections connected by a replaceable, flexible Nylon reinforced Neoprene element to achieve a maximum natural frequency of 3 Hz. Burst pressure must be a minimum of three (3) times the published maximum operating pressure. All air spring systems shall be equipped with three (3) leveling valves connected to the building control air or a supplementary air supply to maintain elevation plus or minus 1/8" (3 mm). An air filter and water separator shall be installed before the air distribution system to the leveling valves. Submittals shall include natural frequency, as well as load and damping tests, all as performed by an independent lab or acoustician. Air springs shall be Mason #MT and leveling valves Mason #LV, or equal.

I. S-4 Style: Restrained mountings shall include multiple bellow air springs manufactured with powder coated upper and lower steel sections connected by a replaceable, flexible Nylon reinforced Neoprene element to achieve a maximum natural frequency of 3 Hz. Burst pressure must be a minimum of three (3) times the published maximum operating pressure. Mount housing shall include vertical limit stops to prevent spring extension when weight is removed. All restraining bolts shall have large rubber grommets to provide cushioning in the vertical and horizontal directions. A minimum clearance of 3/8" (9 mm) shall be maintained around restraining bolts so as not to interfere with the spring action. Mountings shall have test reports or calculations certifying the maximum allowable horizontal and vertical load ratings. All air spring systems shall be equipped with three (3) leveling valves connected to the building control air or a supplementary air supply to maintain elevation plus or minus 1/8" (3 mm). An air filter and water separator shall be installed before the air distribution system to the leveling valves. Submittals shall include natural frequency, as well as load and damping tests, all as performed by an independent lab or acoustician. Mountings shall be Mason #SLR-MT for steel connections and Mason #SLREBP for concrete connections and leveling valves Mason #LV, or equal.

2.3 SEISMIC RESTRAINED SPRING VIBRATION ISOLATION ROOF-CURB (C-1) (HVAC UNITS 20 TON AND UNDER CAPACITY)

A. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

1. Mason, basis of selection or equal by
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Thybar Corporation.

7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc
10. Vibro-Acoustics, Inc.

B. C-1 Style: Curb mounted rooftop equipment shall be mounted on spring isolation curbs. Curbs shall consist of continuous sheet metal frames above and below isolators. Isolators shall be adjustable, free-standing and laterally stable and include a 1/4" (6 mm) acoustical neoprene cup and leveling bolt. Spring diameters shall be no less than 0.8 of the compressed height of the spring at the rated load with 50% additional travel to solid. Seismic snubbers with an all directional neoprene bushing and 1/4" (6 mm) air gap shall be incorporated into each corner. A continuous sheet metal flashing shall be attached to the upper frame and be separated from the lower frame by a neoprene weatherseal. The sheet metal flashing shall incorporate removable cover plates for adjustment and inspection of isolators after the unit is set. The unit must be solidly fastened to the top steel frame and the lower sheet metal curb must be attached to the roof structure. Curb shall be Mason #ISC Series or equal.

C. C-3 Style: Curb mounted rooftop equipment shall be mounted on vibration isolation bases that fit over the rigid roof curb and under the isolated equipment. The extruded aluminum top member shall overlap the bottom to provide water runoff independent of the seal. Aluminum members shall house electro-galvanized or powder coated springs selected for 0.75" (20 mm) minimum deflection. Travel to solid shall be 1.5" (40 mm) minimum. Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4" (6 mm) so as not to interfere with the spring action except in high winds. Manufacturer's self adhering closed cell sponge gasketing must be used both above and below the base and a flexible EPDM duct like connection shall seal the outside perimeter. Foam or other sliding or shear seals are unacceptable in lieu of the EPDM ductlike closure. Submittals shall include spring deflections, spring diameters, compressed spring height and solid spring height as well as seal and wind resistance details. Curb mounted bases shall be Mason #CMAB Series or equal.

2.4 SEISMIC RESTRAINED SPRING VIBRATION ISOLATION ROOF-CURB (C-2) (HVAC UNITS OVER 20 TON CAPACITY)

A. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

1. Mason, basis of selection or equal by
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Thybar Corporation.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc
10. Vibro-Acoustics, Inc.

B. C-2 Style: Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of 1/4" (6 mm) thick. Steel springs shall be laterally stable and rest on 1/4" (6 mm) thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" (50 mm) of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail, and the lower Z section anchored to the roof structure. Curb shall be Mason #RSC Series or equal.

2.5 VIBRATION ISOLATION STEEL EQUIPMENT BASES

A. Basis-of-Design Product: Subject to compliance with requirements provide a comparable product by one of the following:

1. Mason, basis of selection or equal by
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc
9. Vibro-Acoustics, Inc.

B. B-1 Style: Vibration isolation manufacturer shall furnish integral structural steel bases designed to prevent excessive base flexure at start up, prevent misalignment of equipment and provide attachment points for seismic restraints. Bases shall be rectangular in shape and constructed of welded structural steel angle or channel members. Base shall be Mason #MSL Series or equal.

C. B-2 Style: Vibration isolation manufacturer shall furnish integral structural steel bases designed to prevent excessive base flexure at start up, prevent misalignment of equipment and provide attachment points for seismic restraints. Bases shall be rectangular in shape and constructed of welded wide flange structural steel main members with cross bracing located at or near each restraint location. Where height saving brackets are required, they shall be employed in all mounting locations to maintain a 1" (25 mm) clearance below the base. Base shall be Mason #WFSL Series or equal.

D. B-3 Style: 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 and shall be 6”deep for pumps thru 75 HP and 10” deep for pumps 100 HP thru 250HP. Forms shall include minimum concrete reinforcing consisting of #4 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. Base shall be Mason #BMK Series or #KSL Series or equal.

2.6 SPRING HANGERS

A. H-1 Style: Spring hangers shall consist of rigid steel frames containing minimum 1-1/4" (32 mm)thick neoprene elements at the top and steel springs that are free standing and laterally stable seated in a steel washer reinforced neoprene cup at the bottom. 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. The neoprene element and the cup shall have a neoprene bushing projecting through the steel box. A seismic rebound washer made of steel and surrounding neoprene shall be provided. 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. Hangers shall be Mason #RW30N Series or equal.

2.7 PIPE GUIDES AND SUPPORTS

A. G-1 Style: All-directional acoustical pipe anchors shall consist of two sizes of steel tubing separated by a minimum 1/2" (12 mm) 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 Mason #ADA Series or equal.

B. G-2 Style: Vertical sliding pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" (20 mm) thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of 1-5/8" (41 mm) upwards or downwards motion, or to meet location requirements. Pipe guides shall be Mason #VSG Series or equal.

C. G-3 Style: Horizontal thrust restraints shall consist of a spring element seated in a steel washer reinforced neoprene cup at the bottom, in series with a molded neoprene element. Steel springs shall be free standing and laterally stable. 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. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" (6 mm) movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the ductwork 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 Mason #WBI Series or #WBD Series or equal.

2.8 SWAY BRACING

A. SB-1 Style: Seismic sway braces shall consist of galvanized steel aircraft cables or steel angles or struts. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads with a minimum safety factor of two (2). Brace end connections shall be steel assemblies that swivel to the final installation angle. Steel angles or struts, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps. Do not mix cable and

steel braces to brace the same system or equipment. Cable brace assemblies shall be Mason #SCB Series or #SCBH Series, steel brace assemblies shall be Mason #SSB Series, #SSBS Series or #SHB Series, and rod clamps shall be Mason #SRC Series or #UCC Series or equal.

2.9 FLEXIBLE PIPING CONNECTORS

A. F-1 Style: Flexible spherical expansion joints for pump connections. Shall employ peroxide cured EPDM in the covers, liners and Kevlar tire cord frictioning. 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 190F with a uniform drop in allowable pressure to 190 psi at 250F. 16" and larger connectors are rated 180 psi at 190F and 135 psi at 250F. 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. Manufacturer shall provide pre-stretching charts for expansion joints when used in conjunction with isolated equipment. 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 Mason #SAFEFLEX SFDEJ Series, #SAFEFLEX SFEJ Series, #SAFEFLEX SFDCR Series or #SAFEFLEX SFU Series and Control Rods Mason #CR, or equal.

B. F-2 Style: Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" (75 mm) and larger shall be flanged. Smaller sizes shall have male threaded nipples or copper sweat ends. Hoses must have sufficient length, minimum 12” (300 mm) long, to accept 1/2” (12 mm) intermittent motion without failure. 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 Mason #FFL Flanged Series, #CPSB Copper Sweat Series or #CSAMN Threaded Series, or equal.

C. F-3 Style: Flexible Vee or U-bend braided hose across building or expansion joints. Piping and equipment connections shall be protected against seismic damage by the insertion of braided flexible hose Vee assemblies rated for ±4” (100mm) seismic motion in all planes. Should the application include ±6” (150mm) thermal movement or thermal movement alone, install the Vee so the thermal movement is axial. Vees shall have a minimum burst pressure of four times their rated pressure. Vees in steel lines shall have stainless hose and braid. Copper lines, bronze hose and braid. Guiding and anchoring shall be as recommended by the manufacturer. 60° Vees shall be Mason #VFL flanged braided steel Series, #VMN Threaded Braided Stainless Steel Series or #VCPSB Copper Sweat Series, or equal.

2.10 FLEXIBLE DUCTWORK CONNECTORS

A. F-4 Style: Flexible ductwork connection fabricated of fiberglass canvas with fire resistant rated neoprene and UV resistant coating. Stainless steel metal edge banding. Minimum 4" width: DuroDyne "Durolon" or "Neoprene", or equal.

2.11 BRACING DEVICES FOR EQUIPMENT, PIPING, AND DUCTWORK.

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

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation
3. Cooper B-Line, Inc.
4. Hilti, Inc.
5. Kinetics Noise Control
6. Loos & Co.
7. Mason Industries
8. Tolco Incorporated
9. Unistrut
10. ISAT, Inc
11. Vibro-Acoustics, Inc.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least two (2) times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4" (6 mm) thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Hanger Rod Stiffener: Steel tube, steel slotted support system sleeve or reinforcing steel angle clamped to hanger rod are acceptable.

F. Bushings for Floor-Mounted Equipment Anchorage: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 LOCATION AND APPLICATION OF VIBRATION ISOLATION EQUIPMENT

A. The following Tables provide schedules for vibration devices required for isolation of mechanical equipment provided on the project. Refer to Part 2 above for device specifications.

EXAMINATION

B. Examine areas and equipment to receive vibration isolation and seismic and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

C. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service or agency acceptable to authorities having jurisdiction. Indicate on Drawings, by details, schedules, or a combination of both, the locations where hanger rods for individual pipes and hanger rods for trapeze hangers require hanger rod stiffeners.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Comply with manufacturer's recommendations for selection and application of vibration isolation materials and units except as otherwise indicated. Comply with minimum static deflections recommended by ASHRAE, of vibration isolation materials and units where not otherwise indicated.

C. Comply with manufacturer's instructions for installation and load application to vibration control materials and units except as otherwise indicated. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

D. All vibration isolator systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

E. Installation of vibration isolators must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

F. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

G. 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 attention of the Owner's Representative prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

H. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

I. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

J. Flexible Pipe Connectors: Install on equipment side of shutoff valves.

K. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

L. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolts and mounting hole in concrete base.

M. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

N. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

O. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 VIBRATION ISOLATION OF PIPING

A. Horizontal Piping: The first three pipe supports from vibration isolated equipment must be vibration isolated. The static deflection of the pipe support isolators must be equal to the static deflection for the isolators under the connected equipment. Overhead piping shall suspend from Mason Type 30N spring hangers, or equal. Floor supported piping shall rest on Mason Type SLR isolators, or equal. Refer to contract drawings for additional vibration isolation requirements for piping. Where piping connects to mechanical equipment install Mason Type SFDEJ or SFU expansion joints or Mason Type FFL stainless hoses if Type SFDEJ or SFU is not suitable for the service.

B. Riser isolation: Risers that experience excessive thermal expansion shall be suspended from Mason Type 30N spring hangers or supported by Mason Type SLF(H) spring mountings, anchored with Mason Type ADA(H) anchors, and guided with Mason Type VSG(H) sliding guides. Horizontal pipe runs and branches shall be supported on Mason Type 30N spring hangers for the first three supports from the risers. Steel springs shall be selected to provide a minimum of 0.75"static deflection except in those expansion locations where additional deflection is required to limit load changes to $\pm$ 25% of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 AIR MOUNTING SYSTEM DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230548

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 WORK RELATED IN OTHER SECTIONS

A. Section 230500: Basic HVAC Materials and Methods

B. Section 232113: Hydronic Piping, Valves and Specialties

C. Section 233113: Air Distribution

D. Division 26: Electrical.

1.3 SUMMARY

A. Scope: Extent of testing, adjusting and balancing work required by this Section is indicated on the drawings, in schedules, and by the requirements of this Section, and Section 230500 -Basic Mechanical Requirements.

B. Systems: Testing, adjusting and balancing specified in this Section shall include, but not be limited to, the following systems:

1. Air handling systems including supply, return and exhaust.
2. Air distribution ductwork including supply, return and exhaust.
3. Hydronic system including heating water.
4. Instruction of Owner's personnel for future balancing of systems.

1.4 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Reference Standards

1. ANSI/ASHRAE Standard 111 - Measurement, Testing, Adjusting and Balancing of Building HVAC Systems (current edition).
2. ASHRAE - HVAC Applications Handbook: Chapter 38 - Testing, Adjusting and Balancing (current edition).
3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings, Chapter 6 (current edition).
4. AABC - National Standards for Total System Balance.
5. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
6. SMACNA - HVAC Systems-Testing, Adjusting and Balancing.
7. SMACNA - HVAC Air Duct Leakage Test Manual.
8. ANSI - American National Standards Institute. Comply with the following:

    a. S1.4: Specifications for Sound Level Meters.
    b. S1.11: Specifications for Electroacoustics - Octave-Band and Fractional-Octave-Band Filters

9. Building Code, with State Amendments, Chapter 9 Fire Protection Systems.
10. Mechanical Code, with State Amendments, Chapter 4 Ventilation Air Supply.
11. Local Nonresidential Energy Code.

1.5 QUALITY ASSURANCE

A. Contractor's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, is not the installer of the system to be tested and is otherwise independent of the project. Testing, adjusting, and balancing shall be performed by a certified NEBB technician or a certified AABC technician under direct field supervision of a Certified NEBB Supervisor or a Certified AABC Supervisor. Testing and balancing agency must submit qualifications for review and approval prior to acceptance for work.

B. Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 30 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.

C. Retainages: In addition to any other sums retained or withheld pursuant to the provisions of this Contract, the amount of dollars will be withheld from payments to the contractor until such time as the work has been completed and accepted. In no event will this amount be paid to the Contractor prior to 60 days following acceptance of the project; during such time, the Contractor shall investigate and correct any reported deficiencies unless such deficiencies are a result of unauthorized tampering by building occupants.

D. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 6 months.

E. Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer.

F. The testing and balancing agency shall provide with his bid a performance guarantee covering all phases of the work as herein specified.

G. The General and Mechanical Contractors shall cooperate with the selected testing and balancing agency in the following manner:

1. Provide sufficient time before final completion dates so that tests and balancing can be accomplished.
2. The various system installers, suppliers and contractors shall provide all required materials, labor and tools to make corrections when required without undue delay. Install balancing dampers and valves as required by testing and balancing agency.
3. The contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing.
4. Testing and balancing agency shall be kept informed of any major changes made to the system during construction, and shall be provided with a complete set of Record Drawings.
5. The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work.

H. All air balancing work shall be coordinated with other disciplines to comply with the meet or exceed the minimum requirements of the Americans with Disabilities Act (ADA), Building Code, local amendments and State Energy Code.

1.6 SUBMITTALS

A. Conform to the Submittals requirements of Division 01.

B. Forms: The Contractor shall deliver a complete copy of either NEBB or AABC standard forms for testing and balancing work associated with the project. These forms shall serve as specific guidelines for producing final test report. Hybrid or non-standards forms are not acceptable.

C. Test Reports: Provide six (6) certified test reports, signed by the test and balance supervisor who performed the work. The final reports shall include key plans identifying all inlets and outlets. Final test reports shall be typed. Hand written reports are not acceptable.

D. Maintenance Data: Include, in maintenance manuals, copies of certified and approved test and balance reports and identification of instruments.

E. Qualifications: The Test and Balance Agency shall submit qualifications of all persons responsible for supervising and performing the on-site testing and balancing work and the name of the certifying agency, NEBB or AABC. Provide a reference list of five (5) similar size projects with contact person and telephone number.

1.7 AGENDA

A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.

1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.
2. The agenda shall include a general description of each air and water system with its associated equipment and operation cycles for heating and cooling.
3. The agenda shall include a list of all air and water flows to be performed at all mechanical equipment.
4. The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas such as conference rooms.
5. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.
6. Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch) and factors for:

    a. Air terminal configuration.
    b. Flow direction (supply or exhaust).
    c. Velocity corrections.
    d. Effective area applicable to each size and type of air terminal.
    e. Density corrections.

7. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

1.8 JOB CONDITIONS

A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.

1. Installation and start-up work on equipment or systems to be tested has been completed and documented.
2. Work area scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.

3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested shall be in their completed normal positions and operation.
4. All related mechanical systems which may affect the operation of the system to be tested shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.1 TEST HOLES

A. Test holes and ports shall be provided in ducts, housings and pipes as directed by the Balancing Agency. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.

2.2 PATCHING MATERIALS

A. Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.

1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.
2. Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

2.3 TEST INSTRUMENTS

A. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. The Owner's Representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

B. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against Certified Calibrated instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.

C. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser/grille/register air flow measurements. The readout meters shall meet calibration requirements.

PART 3 - EXECUTION

3.1 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: All systems and components thereof shall be adjusted to perform as required by approved project drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.

1. All instruments shall be applied in accordance with the manufacturer's certified instructions.
2. All labor, instruments, and appliances required shall be furnished by the Contractor. Permanently installed instruments used for the tests (e.g., flow meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation.

3.2 DUCTWORK AIR LEAKAGE TESTING

A. Test and balance agency shall perform active air flow testing of ductwork systems or sections of ductworks. Agency shall inspect and confirm that all ductwork is sealed per the specification requirements prior to performing any testing. Calculate maximum allowable air leakage by system based on total design air flow rate. Maximum allowable system leakage shall not exceed 5%. Test a random sample of 10% of the ductwork. If any ductwork within the sample fails to meet the criteria than an additional 10% (20% total) sample must be measured. If any ductwork within this second 10% sample fails than 100% of all ductwork must be tested and verified to have a leakage rate than does not exceed the maximum allowable limit.

B. Ductwork systems to be leakage tested shall include:

1. Testing shall be performed at 1.5 times the peak design outlet static pressure (external static pressure) from the air handling unit/fan, but not greater than the maximum SMACNA pressure rating of the ductwork construction classification. Testing is not required of flexible ductwork or ductwork downstream of VAV terminal units.
2. Leakage through manufactured products, such as dampers, fire smoke dampers and terminal units may be excluded from the leakage calculations based on manufacturer stated values, at pressure, or these units may be temporarily sealed with painter’s tape during testing to seal any openings and must be removed after testing.
3. Supply air ductwork from the outlet of the air handling unit/fan to inlet side of terminal units or connection to flexible ductwork.
4. All supply, return and exhaust air ductwork located outside the building envelope.
5. Return and exhaust air ductwork located in unconditioned spaces from inlet of the air handling unit/fan to the ductwork terminations upstream of each return air grille.

6. Laboratory and fume hood exhaust air ductwork from inlet of the air handling unit/fan to the connection at the remote exhaust air grille or fume hood connection.
7. Kitchen exhaust air ductwork from inlet of the exhaust fan to the connection at the remote exhaust hood.

C. Ductwork installer shall prepare ductwork for pressure testing as deemed appropriate to maintain construction schedule. Ductwork may be tested as total systems or in sections. Sectional testing will require documentation to prove the totalized system leakage is within allowable range of entire system. Ductwork inlets and outlets may be temporarily sealed airtight with plastic, or other means, to facilitate testing pressures.

D. Testing may occur through ductwork devices such as balancing dampers, smoke fire dampers and coils. Manufacturer provided air leakage allowances for such devices may be excluded from duct leakage measurement but must be documented in final report.

E. Perform all testing utilizing a duct leakage testing system, Oriflow Duct Leakage Tester or equal, with calibrated fan, orifice, gauges, ductwork, pressure tips and tubing.

3.3 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust all air handling systems to provide design air quantity to or through, each component, and to maintain stable and comfortable interior temperatures, free of drafts or stagnant air conditions.

B. Equalizers: Equalizing devices shall be adjusted to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.

C. Balance: Flow adjusting (volume control) devices shall be used to balance air quantities (i.e., proportion flow between various terminals comprising system) to the extent that their adjustments do not create objectionable air motion or sound (i.e., in excess of specified limits).

1. Balancing between runs (submains, branch mains, and branches) generally shall be accomplished by flow regulating devices at, or in, the divided-flow fitting.
2. Restriction imposed by flow regulating devices in or at terminals shall be minimal.
3. Final measurements of air quality shall be made after the air terminal has been adjusted to provide the optimum air pattern of diffusion and as indicated on the air distribution drawings.

D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds or axial-flow fan wheel blade pitch. Damper restriction of a system's total flow may be used only for systems with direct-connected fans (without adjustable pitch blades), provided system pressure is less than 0.5” w.g. and sound level criteria are met.

E. Air Measurement: Where air quantity measuring devices are specified in other sections such systems shall be used as a cross-check of portable measuring equipment.

1. Except as specifically indicated herein, pitot tube traverses shall be made of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE "Handbook Fundamentals Inch Pound Edition."
2. For ducts serving modular office areas with movable partitions, which are subject to change, pitot tube traverses may be omitted provided the duct serves only a single room or space and its design volume is less than 2000 cfm. In lieu of pitot tube traverses, airflow in the duct shall be determined by totaling volume of individual terminals served, measured as described herein.
3. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), air quantity may be determined by measurements at terminals served.

F. Test Holes: Test holes shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.

G. Air Terminal Balancing: Generally, measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for the balancing agenda. Laboratory tests shall be conducted to prove accuracy of testing methodology and test data when so directed. Such tests shall be conducted in conformance with applicable ASHRAE or American Society of Mechanical Engineers (ASME) codes and shall be performed at no additional cost to Owner.

H. Air Motion: Air motion and distribution shall be as specified and indicated on drawings. The Contractor, at no additional cost to the Owner shall, in addition to air motion and direct measurements, perform smoke tests as requested to demonstrate the air distribution and pattern from air terminals and outlets.

I. Air system test and balance procedures shall include, but not be limited to the following requirements:

1. Test and adjust blower RPM to design requirements.
2. Test and record motor full load amperes.
3. Make pitot tube traverse of main supply ducts and obtain design CFM at fans.
4. Test and record system static pressures, suction pressure directly at system fan inlet, and outlet pressure directly at system fan outlet or discharge. Test and record static pressure across each component of air handling system (coils, filters, etc.).
5. Test and adjust system for design CFM recirculated air.
6. Test and adjust system for design CFM outside air.
7. Test and record entering air temperatures.
8. Test and record leaving air temperatures.
9. Adjust all supply, return and exhaust air ducts to proper design CFM.
10. Adjust all zones to proper design CFM, supply and return.
11. Test and adjust duct systems and each diffuser, grille, and/or register to within 10% of design requirements.
12. Each grille, diffuser and register shall be identified as to location and area.
13. Operate each variable frequency drive (VFD) and verify controls installation is complete.

14. Size, type and manufacturer of VAV boxes, diffusers, grilles, registers and all tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.
15. Readings and tests of diffusers, grilles and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustment.
16. In cooperation with the control manufacturer's representative, setting adjustments of automatically operated dampers to operate as specified, indicated, and/or noted. Testing agency shall check all controls requiring adjustment by control installers. Room thermostats shall be checked for cooling and heating response.
17. All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.
18. Adjust overall system balances to allow all self-closing exterior doors to close from any open position. Maximum interior air pressure in all operational modes shall not exceed 0.05" static pressure relative to the outside air pressure. Comply with chapter 10 of the Building Code to assure that self-closing doors will release with a maximum force of 15 pounds.
19. As part of the work of this contract, the HVAC contractor shall make any changes in the pulleys, belts and dampers or the addition of dampers required for correct balance as recommended by air balance agency, at no additional cost to Owner.
20. After air balancing is completed and RPM determined, HVAC Contractor shall provide fixed pitch pulleys.
21. All mixing boxes, VAV air valves, control dampers, smoke dampers and similar devices which operate at 100% shut off shall be tested for leakage.
22. Variable Air Volume Fan Systems: The primary balancing mode is 100% outside air with all terminal boxes on a full call for cooling. Also check and record performance at minimum outside air with all terminal boxes on call for full cooling and at minimum outside air with all terminal boxes on call for full heating and at minimum outside air in the deadband range with no call for heating or cooling. Verify that the systems are operating on a stable part of the fan curves in each mode. Record final duct static controller settings.

3.4 AIR SYSTEM DATA

A. Report: The certified report shall include for each air handling system the data listed below.

1. Equipment (Fan or Factory Fabricated Station Unit):

a. Installation data

1) Manufacturer and model
2) Size
3) Arrangement, discharge and class
4) Motor hp, voltage, phase, cycles, and full load amps
5) Location and local identification data

b. Design data

1) Data listed in schedules on drawings and specifications.

c. Fan recorded (test) data

1) CFM
2) Static pressure (suction and discharge, across each coil and filter set)
3) RPM
4) Motor operating amps
5) Motor operating bhp

2. Duct Systems:

a. Duct air quantities (maximum and minimum) - main, submains, branches, outdoor (outside) air, total air, and exhaust:

1) Duct size(s)
2) Number of pitot tube (pressure measurements)
3) Sum of velocity measurements (Note: Do not add pressure measurements)
4) Average velocity
5) Recorded (test) cfm
6) Design cfm

b. Individual air terminals

1) Terminal identification supply or exhaust, location and number designation
2) Type size, manufacturer and catalog identification applicable factor for application, velocity, area, etc., and designated area
3) Design and recorded velocities - fpm (state "core," "inlet," etc., as applicable)
4) Design and recorded quantities - cfm (deflector vane or diffusion cone settings)

3.5 WATER SYSTEM PROCEDURES

A. Preparation:

1. Open all valves to full open position. Close coil bypass stop valves. Set mixing valve to full coil flow.
2. Remove all strainers and clean same. Reinstall.
3. Examine water system and determine if water has been treated and cleaned.
4. Check pump rotation.
5. Check expansion tank to determine they are not air bound and the system is completely full of water.
6. Check all air vents at high points of water systems and determine that all are installed and operating freely.
7. Check operation of automatic bypass valve.
8. Operate each variable frequency drive (VFD) and verify controls installation is complete.
9. Check and set operating temperatures of all equipment at design requirements.
10. Complete air balance must have been accomplished before actual water balance begins.

B. Adjustment: All heating, cooling and condensing water systems shall be adjusted to provide required quantity to or through each component.

C. Metering: Water quantities and pressures shall be measured with calibrated meters.

1. Venturi tubes, orifices, or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils except room units, converters, etc.) prior to the capacity testing.
2. Where flow metering fittings are not installed, in air/water type heat transfer equipment, flow balance shall be determined by measuring the air side energy differential across the heat transfer equipment. Measurement of water temperature differential shall be performed with the air system, adjusted as described herein, in operation.

D. Automatic Controls: Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests.

E. Flow: Flow through bypass circuits at three-way valves shall be adjusted to equal that through the supply circuit, when the valve is in the bypass position.

F. Distribution: Adjustment of distribution shall be effected by means of balancing devices (cocks, valves, and fittings) and automatic flow control valves as provided. Manual service valves shall not be used for balancing.

1. Where automatic flow control valves are utilized in lieu of Venturi tubes, only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.

G. Special Procedures: Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

H. Water System Test and Balance Procedure: Perform the following tests, and balance each system in accordance with the following requirements:

1. Set chilled, heating and condenser water pumps to proper gallons per minute delivery.
2. Adjust heating water flow through boiler(s).
3. Test and record entering and leaving water temperatures through chillers, boilers, heat exchangers and cooling towers/fluid coolers.
4. Test and record water temperatures at inlet and outlet side of each terminal unit. Note rise or drop of temperatures from source.
5. Proceed to balance each terminal unit.
6. Upon completion of flow readings and adjustments at coils, mark all settings and record data.
7. After adjustments to coils are made, recheck settings at the pumps, chiller, boilers, and cooling towers and readjust if required.
8. Record and check the following items at each coil.

a. Inlet water temperatures.
b. Leaving water temperatures.
c. Water pressure drop of each coil.

9. Pump operating suction and discharge pressures and final total dynamic head.
10. List all mechanical specifications of pumps.
11. Rated and actual running amperage of pump motor.
12. Water metering device readings.

3.6 WATER SYSTEM DATA

A. Report: The certified report for reach water system shall include the data listed below.

1. Pumps:

a. Installation data

1) Manufacturer and model
2) Size
3) Type drive
4) Motor hp, voltage, phase, and full load amps

b. Design data

1) GPM
2) Head
3) RPM and amps

c. Recorded data

1) Discharge pressures (full-flow and no-flow)
2) Suction pressures (full-flow and no-flow) operating head
3) Operating gpm (from pump curves if metering is not provided) no-load
4) Amps
5) Full-flow amps
6) No-flow amps

2. Air Heating and Cooling Equipment:

a. Design data

1) Load in Btuh or MBh
2) GPM
3) Entering and leaving water temperature
4) Entering and leaving air conditions (DB and WB)
5) CFM
6) Water pressure drop
7) Entering steam pressure

b. Recorded data

1) Type of equipment and identification (location or number designation)
2) Entering and leaving air conditions (DB and WB)
3) Entering and leaving water temperatures
4) GPM
5) Temperature rise or drop
6) Entering steam pressure

3. Boilers:

a. Installation data

1) Manufacturer and model
2) Motor hp, voltage, cycles, phase, and full load amps
3) Part load amperes
4) GPM
5) Water pressure drop
6) Entering and leaving water temperature

b. Recorded data

1) GPM
2) Water pressure drop
3) Entering and leaving water temperature
4) Amperes

4. Heat Exchangers:

a. Installation Data

1) Manufacturer, model, and type
2) Flow rate
3) Inlet (entering) and outlet (leaving) temperatures
4) Inlet (entering) and outlet (leaving) pressures

b. Recorded Data

1) Flow rate
2) Entering and leaving water temperatures
3) Entering and leaving pressures

3.7 MEASUREMENT TOLERANCES

A. Set system air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Heating Water Flow Rate: Plus or minus 10 percent.

3.8 CERTIFIED REPORTS

A. Submittals: Six (6) copies of the reports described herein, covering air and water system performance, air motion (fpm), and sound pressure levels, shall be submitted prior to final tests and inspection.

B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.

C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious malfunction and design deficiencies.

D. Certification: Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.9 FINAL COMMISSIONING TESTS, INSPECTIONS AND ACCEPTANCE

A. Scope: Test shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.

1. At the time of final inspection, the Contractor shall recheck, random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report. In addition, all courtrooms, auditoriums, and conference rooms shall be rechecked.
2. Points and areas for recheck shall be selected by the commissioning team.
3. Measurement and test procedures shall be the same as approved for work forming basis of certified report.
4. Selections for recheck (specific plus random), in general, will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from design, or a sound level greater than 2 db or more than recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost. Retainage time shall be based on the date of the final acceptance of the certified report.

C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION 230593

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, providing insulation for the following:

1. Ductwork Insulation:

a. Duct wrap insulation.

2. Section Includes insulating the following duct services:

a. All supply air ductwork, unless otherwise shown on drawings.

3. Plenums and equipment rooms, as noted.

B. Types of mechanical insulation specified in this Section include the following:

1. Duct wrap insulation: Glass Mineral Wool also known as fiberglass.
2. Duct wrap insulation: Flexible elastomeric foam.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic HVAC Materials and Methods.

B. Section 233113 Air Distribution

1.4 DEFINITIONS

A. Ambient: The air temperature to be maintained in a conditioned room. Typically, between 70°F and 78°F.

B. Insulation Group (IG): Definition of Insulation Materials and Operating Temperatures.

C. Vapor Barrier Jacket: Insulation jacket material that impedes the transmission of water vapor.

D. Unconditioned Space: any space not directly conditioned by mechanical equipment or maintained to temperature by mechanical equipment.

1.5 INSULATION INDUSTRY DEFINITIONS

A. UL GREENGUARD: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by EPA, OSHA, and WHO.

B. EPA: Environmental Protection Agency.

C. WHO: World Health Organization.

D. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.

E. ASJ: All Service Jacket (no outer film).

F. SSL+: Self-Sealing Lap with Advanced Closure System.

G. SSL: Self-Sealing Lap.

H. FSK: Foil Scrim Kraft; jacketing.

I. FSP: Foil Scrim Polyethylene jacketing

J. PSK: Poly Scrim Kraft; jacketing.

K. PVC: Polyvinyl Chloride.

L. FHC: Fire Hazard Classification

M. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety risk of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.

N. ECOSE Technology: a proprietary binder system based on rapidly renewable bio-based materials; rather than petroleum-based chemicals commonly used in other glass mineral wool insulation materials. ECOSE Technology reduces the binder embodied energy by up to 70 percent and does not contain phenol, formaldehyde, acrylics or artificial colors.

O. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.

P. Recycled Content – Post-Consumer: materials such as bottled glass collected at curbside or other collection sites after consumer use and used in the manufacturing process to create a new product rather than being placed in a landfill or incinerated.

Q. Recycled Content – Pre-Consumer (aka Post-Industrial): materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.

R. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE and Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.

S. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL classifies products to applicable UL requirements standards for safety and standards of other National and International organizations

T. Imperative 11, Red List – requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the "worst in class" materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.

U. Underwriter's Laboratories Environment (UL Environment): offers independent green claims validation, product assessment and certification.

V. UL Environment Claims Validation (ECV): service and label tests a manufacturer's product and validates that the environmental claims they make in their marketing and packaging materials are factual. This ECV service enables products to qualify for LEED® MR Credit 4 Recycled Content LEED-NC 2009 or New LEED V-4 Building product disclosure and optimization – sourcing of raw materials.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:

1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM Standards, including:

a. B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plat.
b. C165 - Recommended Practice for Measuring Compressive Properties of Thermal Insulation.
c. C167 - Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
d. C168 – Terminology for Thermal Insulation
e. C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission by Means of the Guarded Hot Plate Apparatus.
f. Properties by Means of the Guarded-Hot-Plate Apparatus.
g. C195 - Specification for Mineral Fiber Thermal Insulating Cement.
h. C196 - Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement.
i. C302 - Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.
j. C303 - Test Method for Density of Preformed Block-Type Thermal Insulation.
k. C305 - Test for Thermal Conductivity of Pipe Insulation.
l. C356 - Test for Linear Shrinkage of Preformed High-Temperature Thermal Insulation.
m. C411 - Test for Hot-Surface Performance of High Temperature Thermal Insulation.
n. C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
o. C449 - Specification of Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
p. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
q. C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.
r. C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
s. C547 - Specification for Mineral Fiber Preformed Pipe Insulation.
t. C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.
u. C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
v. C755 – Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
w. C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
x. C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
y. C921 - Practice for Determining Properties of Jacketing Materials for Thermal Insulation.
z. C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
aa. C1071 - Standard Specification for Thermal and Acoustical Insulation.
bb. C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
cc. C1290 – Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

dd. C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
ee. E84 - Test Method for Surface Burning Characteristics of Building Materials.
ff. E119 - Test for Fire Resistance.
gg. G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
hh. G22 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Bacteria.
ii. EE2336 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the following ASHRAE Standard:

   a. 90 - Energy Conservation in New Building Design.

3. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:

   a. 255 - Test Methods, Surface Burning Characteristics of Building Materials.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Do not provide materials with flame proofing treatments subject to deterioration due to the effects of moisture or high humidity.

D. Products Containing Prohibited Chemicals:

1. Products containing the following prohibited chemicals for use as flame retardants or for other purposes will not be acceptable when present in quantities greater than 0.1% by mass:

   a. Pentabrominated diphenyl ether (CAS#32534-81-9)
   b. Octabrominated diphenyl ether (CAS#32536-52-0)
   c. Decabrominated diphenyl ether (CAS#1163-19-50

E. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing; or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

F. Corrosiveness: Passes ASTM C1617-05, Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals.

G. Insulation thickness shall be the greater standard of that specified here or the State energy conservation requirements.

H. Sustainable Project Requirements:

1. Formaldehyde Free: Third party certified with UL Environment Validation or Scientific Certification Systems (SCS).
2. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).
3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of GREENGUARD Certification.
4. Note to Editor: If your project is Living Building Challenge, include this requirement: Living Building Challenge-Declare Red List Free.

1.7 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation. Also furnish necessary test data certified by an independent testing laboratory. Submit samples.

I. Provide a statement with the submittal indicating that no product submitted contains an amount equal to or greater than 0.10% by mass of the following chemicals:

1. Pentabrominated diphenyl ether (CAS#32534-81-9)
2. Octabrominated diphenyl ether (CAS#32536-52-0)
3. Decabrominated diphenyl ether (CAS#1163-19-5)

J. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product in maintenance manual.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Store and protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.8 WARRANTY

A. Refer to Section 230500 for basic warranty requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design is insulation provided by Knauf, Johns Manville, Owens-Corning, Armstrong, Pittsburgh-Corning, Trymer, IIG, Certainteed, Halstead, Rubatex, 3M FireMaster, Pabco, Reflectix, or approved equal. Manufacturer and insulation types listed below indicate a minimum acceptable level of quality required for each classification.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds if possible. Products shall be certified UL GREENGUARD Gold or Indoor Advantage Gold if possible.

C. UL Environment or GREENGUARD Certification shall validate that each product is formaldehyde free.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.3 DUCT WRAP INSULATION:

A. Type DW-A Flexible Glass Mineral Wool Blanket bonded with a bio-based thermosetting resin. Comply with ASTM C553, Type I, II, and III and ASTM C1290, Type I. UL/ULC Classified per UL 723 for FSK; FHC 25/50 per ASTM E 84. UL GREENGUARD, UL Environment, or Scientific Certification Systems (SCS) validated as formaldehyde free, DecaBDP free. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Knauf Insulation; Atmosphere Duct Wrap with ECOSE Technology, Owens Corning SOFTR Duct Wrap FRK, or equal.

a. Application: Insulation wrap for ductwork, or other HVAC systems.

2. 'K' Value: ASTM C553-92, 0.27 Btu•in./(hr•ft²•ºF) at 75°F installed full thickness.
3. Density: 1.0 lb/cu ft.
4. Vapor Barrier Jacket: FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with glass mineral wool yarn and laminated to fire-resistant kraft.
5. Installation: See Part 3 below.

B. Type DW-B Elastomeric Foam Flexible Insulation: Armacell Industries model AP Armaflex and AP Coilflex, or equal:

1. Greenguard certified, low VOC.
2. Elastomeric foam insulation with acrylic polymer airstream coating.
3. K' Value: ASTM C518, 0.25 Btu•in./(hr•ft²•ºF) at 75°F.
4. R' value per inch thickness: ASTM C518, 4.0 (hr•ft²•ºF) / Btu at 75°F.
5. Density: ASTM D 1622, 3.0-6.0 lb/ft3.
6. Water vapor sorbtion: ASTM C 1104, less than 2% by weight.
7. Fungal and bacteria resistance: ASTM G 21/22, no growth.
8. Noise Reduction Coefficient: ASTM C 423, 0.49 or higher based on "Type A mounting."
9. Maximum Velocity on Mat or Coated Air Side: 5,000 ft/min.
10. Maximum operating temperature: 250 degrees F.
11. Flame spread index: ASTM E84, less than 25
12. Smoke developed index: ASTM E84, less than 50
13. Adhesive: UL listed waterproof type compliant with ASTM C916.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, the following are acceptable products: Aeroflex USA, Inc.; Aeroseal, Armacell LLC; Armaflex 520 Adhesive, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements the following are acceptable products including Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25, or equal.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, the following are acceptable products including, Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82, Eagle Bridges - Marathon Industries; 225, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following products: Dow Corning Corporation; 739, Dow Silicone, Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive, P.I.C. Plastics, Inc.; Welding Adhesive, Speedline Corporation; Polyco VP Adhesive, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90, Vimasco Corporation; 749, or equal.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180°F (Minus 29 to plus 82°C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30, Eagle Bridges - Marathon Industries; 501, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35, Mon-Eco Industries, Inc.; 55-10, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180°F (Minus 18 to plus 82°C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel, Eagle Bridges - Marathon Industries; 570, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220°F (Minus 46 to plus 104°C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10, Eagle Bridges - Marathon Industries; 550, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50, Mon-Eco Industries, Inc.; 55-50, Vimasco Corporation; WC-1/WC-5, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180°F (Minus 29 to plus 82°C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36, Vimasco Corporation; 713 and 714, or equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180°F (Minus 18 to plus 82°C).
5. Color: White.

2.7 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44, Mon-Eco Industries, Inc.; 44-05, or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 1241°C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76, or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 121°C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 428 AWF ASJ, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836, Compac Corporation; 104 and 105, Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ, or equal.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 491 AWF FSK, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827, Compac Corporation; 110 and 111, Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ, or equal.
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 370 White PVC tape, Compac Corporation; 130, Venture Tape; 1506 CW NS, or equal.
2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 488 AWF, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800, Compac Corporation; 120, Venture Tape; 3520 CW, or equal.
2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.9 SECUREMENTS

A. Bands:

1. Subject to compliance with requirements, provide one of the following products: ITW Insulation Systems, Gerrard Strapping and Seals, RPR Products, Inc., Insul-Mate Strapping, Seals, and Springs, or equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304, 0.020 inch (0.50 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.

4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

    a. Subject to compliance with requirements, provide one of the following products: AGM Industries, Inc.; CWP-1, GEMCO; CD, Midwest Fasteners, Inc.; CD, Nelson Stud Welding; TPA, TPC, and TPS, or equal.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

    a. Subject to compliance with requirements, provide one of the following products: AGM Industries, Inc.; CHP-1, GEMCO; Cupped Head Weld Pin, Midwest Fasteners, Inc.; Cupped Head, Nelson Stud Welding; CHP, or equal.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

1) Subject to compliance with requirements, provide one of the following products: AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers, GEMCO; Perforated Base, Midwest Fasteners, Inc.; Spindle, or equal.

a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
b. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel coordinated with application, fully annealed, 12 gauge, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following: GEMCO; Nylon Hangers, Midwest Fasteners, Inc.; Nylon Insulation Hangers, or equal.
b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers, GEMCO; Peel & Press, Midwest Fasteners, Inc.; Self Stick, or equal.
b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, Stainless steel, fully annealed, as coordinated with application. 12 gauge, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.015-inch- (0.41-mm-) thick, galvanized-steel, aluminum, or stainless-steel sheet, as coordinated with application with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; RC-150, GEMCO; R-150, Midwest Fasteners, Inc.; WA-150, Nelson Stud Welding; Speed Clips, or equal.
b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following: GEMCO, Midwest Fasteners, Inc, or equal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: C & F Wire, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that ductwork has been tested for leakage in accordance with specifications before applying insulation materials. All ductwork shall be inspected by Owner's Representative prior to installation of insulation. Any insulation applied prior to inspection shall be removed and new insulation applied at no additional cost to Owner. Notify Owner's Representative five (5) working days prior to insulation installation.

B. Verify that all surfaces are clean, dry and free of foreign material.

3.2 INSTALLATION

A. General:

1. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
2. Remove and replace any insulation that has become wet or damaged during the construction process.
3. Continue insulation and vapor barrier at penetrations and duct supports, except where prohibited by code. Instances where this is required include:

a. Ductwork support angle or struts.

1) To prevent crushing of low density insulation, provide separator or high density insulation at point of support. A 12 inch wide strip of 6pcf density, glass mineral wool board, or similar mfg/product, across the bottom side of the duct. Vapor barrier to continue unbroken at point of support.
2) As an alternative method, where the duct sits directly on the Unistrut or similar support, install board material on either side of the support to allow duct wrap to be tented over the support, providing a smooth transition over the support and maintaining thickness. 3pcf board may be used in this method.

B. Insulation Applied over the Exterior of the Duct:

1. Provide insulated ductwork conveying air below ambient temperature (below room temperature) with vapor retardant jacket.
2. Seams/joints of duct wrap shall be secured with outward clinching galvanized staples spaced 4" O.C. Vapor barrier tape shall not be used as the sole means of securing the insulation facing.
3. Seal all vapor retardant jacket seams and penetrations with 3" wide pressure-sensitive vapor barrier tape matching the insulation facing.
4. Provide insulated ductwork conveying air above ambient temperature (above room temperature) with or without vapor retardant jacket. Where service access is required, bevel and seal ends of insulation.
5. Continue insulation through walls, sleeves, hangers, and other duct penetrations except where prohibited by code.
6. The insulation shall be firmly wrapped around the ducts with all joints lapped a minimum of 2" and secured with stapes spaced 4" O.C. The vapor barrier shall be sealed with FSK or metallic pressure sensitive tape. Installed thickness shall not exceed 25% compression. The underside of duct work 24" or greater in width shall be secured with mechanical fasteners and speed clips spaced approximately 18" on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then, when required, sealed with the same tape as specified above.

3.3 DUCTWORK INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed ASHRAE 90.1 2013, IECC 2012, State and Local energy code and mechanical code requirements as noted below. Minimum thermal resistance in range of 4.2 to 4.6 per inch of thickness. Insulation thicknesses are based on glass mineral wool insulation and may be adjusted for equivalent insulation values for materials with superior "K" factors.

B. The installed thickness of duct insulation used to determine its R-value shall be determined as follows:

1. For duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
2. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.

3. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.

C. All air distribution system ducts and plenums, but not limited to, building cavities, mechanical closets, air handler boxes, and support platforms used as ducts or plenums, shall be installed, sealed, and insulated to meet the requirements of the code. Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum level of R-8.

1. Outdoors; or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawlspace; or
5. In other unconditioned spaces.

D. TABLE 1: DUCT WRAP INSULATION SERVICE, THICKNESS, AND MATERIAL TYPE REQUIRED.

Flexible Duct wrap:

SYSTEM	THICKNESS (inches)	FINISH	REMARKS/MATERIAL OPTIONS
Supply ducts within building envelope	1-1/2	FSK	Type DW-A, B
Supply or return duct installed as exposed ductwork in the atmosphere controlled occupied space.	0		Except where noted on drawings for acoustical reasons.

Thicknesses in the above table shall have insulation values as follows: 1-1/2" = R-4.2, 2" = R-5.6, 3" = R-8.3. Greater thicknesses are permitted to achieve identical values if space constraints allow.

END OF SECTION 230713

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, providing insulation for the following:

1. Piping Insulation:

a. Piping Insulation.
b. Insulation Jackets.
c. Removable Covers.

2. Acoustic piping wrap

3. Section includes the following HVAC piping systems:

a. Heating hot water supply and return piping.

B. Types of mechanical insulation specified in this Section include the following:

1. Pipe insulation: Glass Mineral Wool.
2. Pipe insulation: Closed cell phenolic.
3. Pipe insulation: Polyisocyanurate.
4. Pipe insulation: Calcium silicate.
5. Pipe insulation: Cellular glass.
6. Pipe insulation: Flexible elastomeric closed cell foam.
7. Insulation jackets.
8. Removable covers.
9. Insulation accessories.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Division 22: Plumbing.

B. Section 230500: Basic HVAC Materials and Methods.

C. Section 232113: Hydronic Piping, Valves and Specialties.

1.4 DEFINITIONS

A. Ambient: The air temperature to be maintained in a conditioned room. Typically, between 70°F and 78°F.

B. Insert: Spacer placed between the pipe support system and the piping to allow for the space required for insulation.

C. Insulation Group (IG): Definition of Insulation Materials and Operating Temperatures.

D. Insulation Shield: Buffer material placed between the pipe support system and the insulation to prevent the insulation material from crushing.

E. Jacket: Protective covering over the pipe insulation; may be factory applied such as “all service jacket” or field applied to provide additional protection; of such materials as canvas, PVC, aluminum or stainless steel.

F. Piping Insulation: Thermal insulation applied to prevent heat transmission to or from a piping system.

G. Vapor Barrier Jacket: Insulation jacket material that impedes the transmission of water vapor.

H. Freezing Climate: Where outdoor design temperature is less than 34°F (1°C), as stated in ASHRAE Fundamentals under 99% column for winter design conditions.

I. Unconditioned Space: any space not directly conditioned by mechanical equipment or maintained to temperature by mechanical equipment.

1.5 INSULATION INDUSTRY DEFINITIONS

A. Third Party Independent Product sustainable certification: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by EPA, OSHA, and WHO.

1. UL GREENGUARD:
2. Scientific Certification Systems (SCS)

B. EPA: Environmental Protection Agency.

C. WHO: World Health Organization.

D. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.

E. ASJ: All Service Jacket (no outer film).

F. SSL+: Self-Sealing Lap with Advanced Closure System.

G. SSL: Self-Sealing Lap.

H. FSK: Foil Scrim Kraft; jacketing.

I. FSP: Foil Scrim Polyethylene jacketing

J. PSK: Poly Scrim Kraft; jacketing.

K. FHC: Fire Hazard Classification

L. PVC: Polyvinyl Chloride.

M. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety risk of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.

N. Bio based Binder Technology: binder systems based on rapidly renewable bio-based materials; rather than petroleum-based chemicals commonly used in other glass mineral wool insulation materials. Biobased Technology reduces the binder embodied energy by up to 70 percent and does not contain phenol, formaldehyde, acrylics or artificial colors.

O. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.

P. Recycled Content – Post-Consumer: materials such as bottled glass collected at curbside or other collection sites after consumer use and used in the manufacturing process to create a new product rather than being placed in a landfill or incinerated.

Q. Recycled Content – Pre-Consumer (aka Post-Industrial): materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.

R. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE and Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.

S. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL classifies products to applicable UL requirements standards for safety and standards of other National and International organizations

T. Imperative 11, Red List – requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the "worst in class" materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.

U. Underwriter's Laboratories Environment (UL Environment): offers independent green claims validation, product assessment and certification.

V. UL Environment Claims Validation (ECV): service and label tests a manufacturer's product and validates that the environmental claims they make in their marketing and packaging materials are factual. This ECV service enables products to qualify for LEED® MR Credit 4 Recycled Content LEED-NC 2009 or New LEED V-4 Building product disclosure and optimization – sourcing of raw materials.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:

1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM Standards, including:

a. B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plat.
b. C165 - Recommended Practice for Measuring Compressive Properties of Thermal Insulation.
c. C168 - Provides standard terminology for thermal insulation.
d. C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
e. C195 - Specification for Mineral Fiber Thermal Insulating Cement.
f. C196 - Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement.
g. C302 - Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.
h. C303 - Test Method for Density of Preformed Block-Type Thermal Insulation.
i. C305 - Test for Thermal Conductivity of Pipe Insulation.
j. C356 - Test for Linear Shrinkage of Preformed High-Temperature Thermal Insulation.
k. C411 - Test for Hot-Surface Performance of High Temperature Thermal Insulation.
l. C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
m. C449 - Specification of Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
n. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

o. C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.
p. C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
q. C547 - Specification for Mineral Fiber Pipe Insulation.
r. C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.
s. C553 - Specification for Mineral Fiber Blanket-Type Pipe Insulation (Industrial Type).
t. C592 - Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered).
u. C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
v. C755 – Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
w. C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
x. C916 – Standard Specification for Adhesives for Duct Thermal Insulation.
y. C921 - Practice for Determining Properties of Jacketing Materials for Thermal Insulation.
z. C1071 - Standard Specification for Thermal and Acoustical Insulation.
aa. C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
bb. C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
cc. C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
dd. C1393 – Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.
ee. C1617-05, Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
ff. E84 - Test Method for Surface Burning Characteristics of Building Materials.
gg. E119 - Test for Fire Resistance.
hh. G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
ii. G22 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Bacteria.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the following ASHRAE Standard:

   a. 90 - Energy Conservation in New Building Design.

3. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:

   a. 255 - Test Methods, Surface Burning Characteristics of Building Materials.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Do not provide materials with flame proofing treatments subject to deterioration due to the effects of moisture or high humidity.

D. Products Containing Prohibited Chemicals:

1. Products containing the following prohibited chemicals for use as flame retardants or for other purposes will not be acceptable when present in quantities greater than 0.1% by mass:

    a. Pentabrominated diphenyl ether (CAS#32534-81-9)
    b. Octabrominated diphenyl ether (CAS#32536-52-0)
    c. Decabrominated diphenyl ether (CAS#1163-19-50

E. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing; or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

F. Corrosiveness: Passes ASTM C1617-05, Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals.

G. Insulation thickness shall be the greater standard of that specified here or the State energy conservation requirements.

H. Sustainable Project Requirements:

1. Formaldehyde Free: Third party certified with UL Environment or Scientific Certification Systems (SCS) Validation.
2. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).
3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of GREENGUARD Certification.

4. Living Building Challenge-Declare Red List Free.

1.7 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Provide a statement with the submittal indicating that no product submitted contains an amount equal to or greater than 0.10% by mass of the following chemicals:

1. Pentabrominated diphenyl ether (CAS#32534-81-9)
2. Octabrominated diphenyl ether (CAS#32536-52-0)
3. Decabrominated diphenyl ether (CAS#1163-19-50)

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product in maintenance manual.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Store and protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.9 WARRANTY

A. Refer to section 230500 for basic warranty requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include KNAUF Insulation, Johns Manville, Owens-Corning, Armstrong, Pittsburgh-Corning, Trymer, IIG, Certainteed, Halstead, Rubatex, 3M FireMaster, Pabco, Reflectix, or approved equal. Manufacturer and insulation types listed below indicate a minimum acceptable level of quality required for each classification.

2.2 PIPE INSULATIONS

A. Type PI-A: Molded glass mineral wool pipe insulation meeting ASTM C547 Type I, 850°F or Type IV, 1000°F Materials: Glass mineral wool bonded with a bio-based thermosetting resin. FHC 25/50 per ASTM E 84 for Redi-Klad Pipe Product to be validated formaldehyde free. In addition, pipe insulation to have a validated EPD from UL Environment or Scientific Certification Systems. Comply with ASTM C 585, ASTM C 411, ASTM C 795, and ASTM C

547, Type I, and Type IV, with factory-applied ASJ+ or ASJ interior and with factory-applied ASJ+-SSL+ or ASJ-SSL for exterior. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Applications: Insulation of piping up to 3" thick insulation.
2. Semirigid board material with factory-applied ASJ or FRK/FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB.

3. Nominal density is 2.5 lb/cu. ft. unjacketed or more.
4. Thermal conductivity (k-value) per ASTM C547 at 100°F is 0.29 Btu in./h sq. ft. °F or less.
5. Basis-of-Design Product: Subject to compliance with requirements, provide pipe Insulation or comparable product by one of the following: Knauf ECOSE, Owens Corning, CertainTeed Corp., Johns Manville Miro-Lok, Micro-Lok HP, Manson Insulation Inc, or equal.
6. Maximum Service Temperature per ASTM 547: 850°F to 1000°F.
7. Vapor Retarder Jacket: ASJ+ SSL+ outer film layer, white kraft paper interleaving reinforced with glass fiber scrim yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips.

B. Type PI- B: Closed cell phenolic foam: Trymer Supercel, Kingspan Koolphen K, Resolco Insulphen, or approved equal meeting ASTM C 1126.

1. 'K' Value: 0.16 at 75°F (24°C)
2. Maximum Continuous Service Temperature: 300°F.
3. Vapor Retarder Jacket – straight sections: Saran 540/SSL or Mylar laminate, factory applied with self-sealing lap.
4. Vapor Retarder Jacket - fittings: Saran 540/SSL spiral wrapped in field for fittings.

C. Type PI- C: Rigid polyisocyanurate foam: Trymer 2000 XP, HiTHERM HT-300, Duna Corafoam, Dyplast ISO-25, or approved equal meeting ASTM C 591.

1. 'K' Value: 0.19 at 75°F (24°C)
2. Maximum Continuous Service Temperature: 300°F.
3. Vapor Retarder Jacket: Saran 540/SSL or Mylar laminate.

D. Type PI-D: Hydrous Calcium Silicate: Johns Manville Industrial Insulation Group Thermo-12 Gold, ASTM C533; Rigid Molded Pipe or equal.

1. 'K' Value: 0.397 at 300°F.
2. Maximum Service Temperature: 1,200°F.
3. Compressive Strength (block): Minimum of 200 psi to produce 5% compression at 1½" thickness.
4. Tie Wire: 16 gauge stainless steel with twisted ends on maximum 12" centers.
5. Product must contain corrosion inhibiting chemistry.

E. Type PI-E: Cellular Glass: Pittsburgh-Corning Foamglas or equal Meeting ASTM C522: Cellular Glass Thermal Insulation:

1. 'K' Value: 0.35 at 75°F.
2. Density: 8.0 lbs./cu. ft.
3. Maximum Service Temperature: 900°F.
4. Vapor Retarder Jacket – straight sections: Saran 540/SSL or Mylar laminate, factory applied with self-sealing lap.
5. Vapor Retarder Jacket - fittings: Saran 540/SSL spiral wrapped in field for fittings.

F. Type PI-F: Flexible Elastomeric Closed Cell Thermal Insulation: Armacel AP Armaflex, Rubatex K-Flex ECO, Aeroflex Aerocel, closed-cell, halogen free, elastomeric insulation. Comply with ASTM-C177, ASTM E 84 and UL 181.

1. 'K' Value: 0.27 at 75°F.
2. Density: 3.0 to 6.0 lbs./cu.ft.
3. Maximum Service Temperature: 260°F.
4. Seal all seams and joints with contact adhesive.

G. Field Applied Jackets (For Interior Applications):

1. All longitudinal seams shall be located on bottom of pipes.
2. PVC Plastic: Johns Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white. Connect with tacks and pressure sensitive color matching vinyl tape.
3. Canvas Jacket: UL listed fabric, 6 oz/sq. yd. plain weave cotton, treated with dilute fire retardant lagging adhesive.
4. Aluminum Jacket: 0.016" thick sheet, smooth or embossed finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.
5. Secure aluminum jackets with 3/8" or ½" stainless steel bands on 12" centers.

2.3 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds if possible. Products shall meet UL GREENGUARD certification standards for low-emitting products.

C. UL Environment shall validate that each product is formaldehyde free.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 1200°F (10 to 649°C).

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97, Johns Manville Industrial Insulation Group CalBond Gold, Marathon Industries; 290, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27, Mon-Eco Industries, Inc.; 22-30, Vimasco Corporation; 760, or equal.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200°F (minus 73 to plus 93°C).

1. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 °F (minus 59 to plus 149°C).

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following: Aeroflex USA, Inc.; Aeroseal, Armacell LLC; Armaflex 520 Adhesive, Foster Brand,

Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive, or equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company, CP-127.Eagle Bridges - Marathon Industries; 225, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25, or equal.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82,Eagle Bridges - Marathon Industries; 225, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following: Dow Corning Corporation; 739, Dow Silicone, Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive, P.I.C. Plastics, Inc.; Welding Adhesive, Speedline Corporation; Polyco VP Adhesive, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90, Vimasco Corporation; 749, or equal.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180°F (Minus 29 to plus 82°C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30, Eagle Bridges - Marathon Industries; 501, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35, Mon-Eco Industries, Inc.; 55-10, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180°F (Minus 18 to plus 82°C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements,provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel, Eagle Bridges - Marathon Industries; 570, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220°F (Minus 46 to plus 104°C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10, Eagle Bridges - Marathon Industries; 550, Foster Brand, Specialty Construction

Brands, Inc., a business of H. B. Fuller Company; 46-50, Mon-Eco Industries, Inc.; 55-50, Vimasco Corporation; WC-1/WC-5, or equal.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180°F (Minus 29 to plus 82°C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company, CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36, Vimasco Corporation; 713 and 714, or equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180°F (Minus 18 to plus 82°C).
5. Color: White.

2.7 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76, Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45, Mon-Eco Industries, Inc.; 44-05, Pittsburgh Corning Corporation; Pittseal 444, or equal.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70, Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45, Mon-Eco Industries, Inc.; 44-05, or equal.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300°F (Minus 73 to plus 149°C).
6. Color: White or gray.

7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44, Mon-Eco Industries, Inc.; 44-05, or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 121°C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76, or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 121°C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.

1. Products: Subject to compliance with requirements, provide one of the following; Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5, or equal.
2. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
3. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab, Vimasco Corporation; Elastafab 894, or equal.

2.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, provide one of the following: Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59, or equal.

2.11 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following: Johns Manville; Zeston, P.I.C. Plastics, Inc.; FG Series, Proto Corporation; LoSmoke, Speedline Corporation; SmokeSafe, or equal.
2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White jackets based on system.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems, ITW Insulation Systems; Aluminum and Stainless Steel Jacketing, RPR Products, Inc.; Insul-Mate, or equal.
2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
    d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

    a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
    d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered withstucco-embossed aluminum-foil facing.

1. Products: Subject to compliance with requirements, provide one of the following: Polyguard Products, Inc, Alumaguard 60, or equal.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 428 AWF ASJ, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836, Compac Corporation; 104 and 105, Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ, or equal.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 491 AWF FSK, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827, Compac Corporation; 110 and 111, Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ, or equal.
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 370 White PVC tape, Compac Corporation; 130, Venture Tape; 1506 CW NS, or equal.
2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 488 AWF, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800, Compac Corporation; 120, Venture Tape; 3520 CW, or equal.
2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.13 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following: ITW Insulation Systems, Gerrard Strapping and Seals, RPR Products, Inc., Insul-Mate Strapping, Seals, and Springs, or equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304, 0.020 inch (0.50 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.

4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

    a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; CWP-1, GEMCO; CD, Midwest Fasteners, Inc.; CD, Nelson Stud Welding; TPA, TPC, and TPS, or equal.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; CHP-1, GEMCO; Cupped Head Weld Pin, Midwest Fasteners, Inc.; Cupped Head, Nelson Stud Welding; CHP, or equal.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers, GEMCO; Perforated Base, Midwest Fasteners, Inc.; Spindle, or equal.
    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel coordinated with application, fully annealed, 12 gauge, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, provide one of the following: GEMCO; Nylon Hangers, Midwest Fasteners, Inc.; Nylon Insulation Hangers, or equal.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers, GEMCO; Peel & Press, Midwest Fasteners, Inc.; Self Stick, or equal.
b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, Stainless steel, fully annealed, as coordinated with application. 12 gauge, 0.106-inch - (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.015-inch- (0.41-mm-) thick, galvanized-steel, aluminum, or stainless-steel sheet, as coordinated with application with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; RC-150, GEMCO; R-150, Midwest Fasteners, Inc.; WA-150, Nelson Stud Welding; Speed Clips, or equal.
b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following: GEMCO, Midwest Fasteners, Inc, or equal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: C & F Wire, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that piping has been tested for leakage in accordance with specifications before applying insulation materials. All piping and ductwork shall be inspected by Owner's Representative prior to installation of insulation. Any insulation applied prior to inspection shall be removed and new insulation applied at no additional cost to Owner. Notify Owner's Representative five (5) working days prior to insulation installation.

B. Verify that all surfaces are clean, dry and free of foreign material.

3.2 INSTALLATION

A. General:

1. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
2. Remove and replace any insulation that has become wet or damaged during the construction process.

B. Piping Insulation:

1. Locate insulation and cover seams in least visible locations unless otherwise specified.
2. Neatly finish insulation at supports, protrusions, and interruptions.
3. Provide insulated dual temperature pipes and cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self-sealing laps. Insulate complete system. Note that staples used on pipes conveying fluids below ambient temperatures (cold systems) must be covered with approved mastic.
4. For insulated pipes conveying fluids above ambient temperature, secure jackets with self-sealing lap or outward clinched, expanded staples. Seal ends of insulation at equipment, flanges, and unions.
5. Provide insert between support shield and piping on piping 1½” diameter or larger. Fabricate of Johns Manville Thermo-12, or other heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:

    a. 1½" to 2½" pipe size: 10" long
    b. 3" to 6" pipe size:12" long
    c. 8" to 10" pipe size: 16" long
    d. 12" and over: 22" long

6. Use of metal saddles is acceptable as specified in Section 230500. Fill interior voids with segments of insulation matching adjoining pipe insulation.
7. Use of pipe hangers designed as an insulation coupling is acceptable in lieu of saddles and other devices. Klo-Shure coupling or equal.

8. For pipe exposed in mechanical equipment rooms or in finished spaces below 7 feet above finished floor, finish with Proto LoSmoke PVC jacket and fitting covers or Johns Manville Zeston PVC jacket.
9. Where pumps, valves, strainers, etc., with insulation require periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.

    a. Cold systems: Provide Armaflex elastomeric foam for pumps and strainers.
    b. Hot Systems: provide removable blanket covers on valves, pumps, and strainers.

10. When maintenance or service access for equipment will result in foot traffic over floor mounted insulated piping the contractor is to fabricate a permanent removable walkway to prevent damage to the piping and insulation.

3.3 PIPING INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed state energy code requirements as noted below. Increase thickness by 1/2" (minimum) where insulated pipe is exposed to exterior ambient air. Minimum thermal resistance shall comply with building code minimum ranges and may exceed those minimum levels. Insulation thicknesses may be adjusted for equivalent insulation values for materials with superior "K" factors.

TABLE 1: PIPING SERVICES, FLUID TEMPERATURE, AND INSULATION TYPE REQUIRED

INSULATION TYPE	INSULATION SUMMARY	
PI-A	Molded glass mineral wool	
PI-B	Closed cell phenolic foam	
PI-C	Rigid polyisocyanurate foam. Limited to non-plenum rated applications.	
PI-D	Hydrous Calcium Silicate	
PI-E	Cellular Glass	
PI-F	Flexible Elastomeric Closed Cell	
SERVICE	INSULATION TYPE / ALLOWED OPTIONS	REMARKS
Heating Water supply and return systems and fittings. (up to 200°F)	Type PI-A, B, C, E	

B. TABLE 2: MINIMUM PIPING INSULATION THICKNESS BASED ON FLUID TEMPERATURE AND PIPING SIZE.

1. California

Insulation Based on California T-24 Energy Code Table 120.3-A Minimum Pipe Insulation Thicknesses or Greater							
FLUID TEMPERATURE RANGE (°F)	**CONDUCTIVITY RANGE (in Btu-inch per hour per square foot °F)**	**INSULATION MEAN RATING TEMPERATURE (°F)**	**NOMINAL PIPE DIAMETER (in inches)**				
			<1	**1 and 1-1/4**	**1-1/2 to <4**	**4 to <8**	**8 and larger**
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating systems (steam, steam condensate and hot water) and Domestic Services Water Heating Systems							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.31	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
40-60 residential	0.21-0.27	75	0.75 for residential		1.0	1.0	1.0
Below 40	0.20-0.27	75	1.0	1.5	1.5	1.5	1.5

END OF SECTION 230700

SECTION 23 21 13

HVAC PIPING, VALVES AND SPECIALTIES

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this section shall include, but not necessarily be limited to, the following:

1. Pipe and Fittings:

    a. Heating water piping above grade
    b. Temperature and Pressure relief
    c. Cold condensate drainage piping (also reference Division 22 for plumbing piping)

2. Valves:

    a. HVAC Service Valves (125 psig max. working pressure)
    b. HVAC Service Valves (250 psig max. working pressure)
    c. Check Valves
    d. Balancing Valves (125 psig working pressure)
    e. Combination HVAC terminal unit valve line sets
    f. Hydronic Service Pressure Reducing Valves
    g. Hydronic Service Pressure Relief Valves

3. Expansion tanks
4. Air separators
5. Hydronic water buffer tank
6. Piping specialties:

    a. Thermometers
    b. Pressure gauges
    c. Expansion Compensators
    d. Pipe escutcheons
    e. Strainers
    f. Drip pans
    g. Air vent
    h. Air elimination valves
    i. Dielectric unions and flanges
    j. Unions

k. Flanges
l. Pipe sleeves
m. Sleeve seals
n. Valve boxes
o. Pipe coating

B. In addition, provide the following:

1. Furnish accessories and labor for flushing and cleaning HVAC piping.
2. Install water treatment systems.
3. Furnish material, accessories and labor for glycol antifreeze charging of new HVAC piping.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01: General Requirements

B. Division 22: Plumbing

C. Division 23: Mechanical

1. Section 230500: Basic HVAC Materials and Methods
2. Section 230593: Testing, Adjusting and Balancing
3. Section 230719: HVAC Piping Insulation

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

B. Codes and Standards:

1. All work shall be in full accordance with all applicable codes, ordinances and code rulings.
2. The Contractor shall furnish without any extra charge the labor and material required for compliance of codes.
3. Perform all tests required by governing authorities and as required under all Division 23 Sections. Provide written reports on all tests.
4. Electrical devices and wiring shall confirm to the latest standards of NEC; all devices shall be UL listed and so identified.
5. All HVAC work shall comply with the Americans with Disabilities Act (ADA).
6. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

C. Product Control

1. Protection: Use all means necessary to protect materials before, during, and after installation and to protect the installed work and materials of all other trades.

2. The general arrangement and locations of piping are shown on the Drawings. Changes may be necessary to accommodate work. Should it be necessary to deviate from arrangement or location indicated in order to meet existing conditions or due to interference with work of other trades, such deviations as offsets, rises and drops in piping that may be necessary, whether shown or not, shall be made without extra expense. Accuracy of data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for assistance and guidance, and exact locations, distances, and elevations will be governed by actual site conditions.
3. All work shall be in accordance with the applicable codes listed in Division 01. No extra charge will be paid for furnishing items required by the regulations but not specified herein or shown on the Drawings. Should there be any direct conflict between the Drawings and/or Specifications and the above rules and regulations, the rules and regulations shall take precedence.
4. All work shall be completely coordinated, and all lines, grades, slopes and vertical and horizontal locations of pipes shall be exactly determined in the field and cleared with the Owner's Representative before the installation of these items is begun. No extra compensation shall be made for failure to observe this clause.
5. The Drawings and Specifications do not undertake to list every item that will be installed. When an item is necessary for the satisfactory operation of the system, it shall be furnished without extra cost. Work called for in the Specifications, but not on the Drawings, or vice versa, shall be done as though required by both. Lack of specific mention of any work necessary for proper completion of the work in the Specifications and/or Drawings, shall not lessen the Contractor's responsibility.
6. Obtain Owner's Representative's approval prior to rerouting of existing services. Refer to Division 01 sections for alterations, shutdown and temporary construction for existing services.
7. Pipe spaces provided in the design shall be utilized and the work shall be kept within the spaces established on the Drawings.
8. Manufacturers' directions shall be followed in all cases where manufacturers of articles used in this Contract furnish directions covering points not shown on the Drawings or specified herein. Manufacturers' directions do not take precedence over the Drawings and Specifications. Where manufacturers' directions are in conflict with the Drawings and Specifications, submit these conflicts to the Owner’s Representative and receive clarification before installing the work.
9. Do not permit or cause any work to be covered or enclosed until it has been inspected, tested, and approved. Should any of the work be enclosed or covered before inspection and test, Contractor shall, at his/her own expense, uncover the work; and, after it has been inspected, tested and approved, make all repairs with such materials as may be required. Restore all work to its original and proper condition.
10. Be responsible for damage to any of this work before acceptance. Securely cover all openings, both before and after setting into place, to prevent obstructions in the pipes and breakage.
11. Repair all damage to the premises occasioned by the work. All damage to any part of the premises caused by leaks or breaks in the pipe installed under this Section of the work for a period of one (1) year after date of final acceptance of the work, shall be repaired.

D. All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less,

and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for all piping, valves and specialties indicating dimensions, valve CV, flow capacity, pressure setting, tolerances etc.

B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, valve replacement, and spare parts lists. Include this data, product data, and shop drawings in operating and maintenance manuals.

C. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable mechanical coupling style number.

1.6 WARRANTY

A. Refer to section 230500 for basic warranty requirements.

B. Provide the following additional extended warranty requirements that apply to piping with mechanical type joints and fittings, such as grooved or pressed/compression type fittings, where installed "inside" the building envelope.

1. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.
2. Contractor and Manufacturer warrant that, for a period of ten (10) years from the date of Certificate of Occupancy (or for such longer period as may be provided under the Contract or law), the entire system, including but not limited to the fittings and joints, will conform to the requirements of the Contract Documents, will be free from defects, and will not leak.
3. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

1. All pipe, pipe fittings and valves shall be manufactured in North America. Alternatives may be acceptable, but must be submitted and approved by the Owner's Representative prior to bidding.

OR

2. Upon request, the Owner's Representative shall be furnished certification by the manufacturer, stating samples representing each lot have been tested and inspected as indicated in governing ASTM specifications have been met. Certification shall be accompanied by test reports as prepared in accordance with relevant ASTM sections governing Test Methods and Inspection. Tension Tests reports shall include breaking load, machined diameter of the test bars, and calculated tensile strength. Certification shall include the legal name and address of the manufacturer.

B. Type M copper piping is not acceptable for any pressure water piping unless specifically noted otherwise.

C. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturers' names used herein, unless specifically noted that substitutes are not allowed.

D. Hydronic Piping Pressure Classifications:

1. Heating Water and Condensate:

a. "Normal Pressure" shall be working fluid pressure up to 125 psig.
b. "High Pressure "shall be working fluid pressure up to 250 psig.

2.2 PIPE AND FITTINGS

B. Heating Water Piping (Above Grade):

1. Steel Pipe: ASTM A53 Grade B, Schedule 40 black steel up to 10" diameter, and Std. Wt. Black steel for 12" diameter and greater.

a. Fittings:
1) Steel normal pressure application: 150 lb. rating. ANSI B16.3, malleable iron threaded; ANSI B16.5, flanged; ANSI B16.9, steel bevel welding
2) Steel high-pressure application: 300 lb. rating. ANSI B16.3, malleable iron threaded; ANSI B16.5, flanges; ANSI B16.9, steel bevel welding.

b. Joints: 2" and smaller, threaded (except in the case of piping located in shafts which must be welded); 2-1/2" and larger, ANSI B16.25 bevel weld, ANSI B16.5 flanges, ANSI B16.11 socket weld.

2. Copper: ASTM B88, Type K or Type L hard drawn copper water tube for normal pressure above grade.

a. Fittings:

1) Copper system: ANSI B16.22, wrought copper with the following connection methods.
   a) Soldered or brazed:
      I. 2” and smaller: Make connections using 95%-5% tin-antimony solder joints above grade and sil-fos brazing below grade.
      II. 2-1/2” and larger: Sil-Fos brazing or brazed and flanged.

C. Temperature and Pressure Relief Valve Discharge Piping:

1. Hydronic Water System (150 psig and 212 deg. F. maximum):

   a. Pipe: Type M or L copper ASTM B88
   b. Pipe: Schedule 40 black steel, ASTM A53 Grade B.
   c. Fittings: ANSI B16.22, wrought copper.
   d. Fittings: 150 lb. rating. ANSI B16.3, malleable iron threaded.
   e. Joints: ANSI B16.22, wrought copper, with 95%-5% tin-antimony solder joints.
   f. Joints: 2" and smaller, threaded (except in the case of piping located in shafts which must be welded); 2-1/2" and larger, ANSI B16.25bevel weld, ANSI B16.5 flanges, or ANSI B16.11 socket weld.

2.3 VALVES: GENERAL

A. General: Valve ratings shall exceed respective system operating pressures by 50% (minimum). All valves shall be line size unless otherwise noted.

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of balancing valve or circuit setter. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve.

C. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

D. Acceptable Manufacturers (manufacturer and model number listed for individual valves indicates minimum acceptable by all manufacturers):

1. Gate or Butterfly: Crane, Bray, Hammond, Gruvlok, Milwaukee, Victaulic, Tyco-Grinnell, Keckley, Keystone, Keystone K-Lok, or Nibco.
2. Ball and Drain Valves: Apollo, Hammond, Milwaukee, Nibco, Victaulic, Tyco-Grinnell, Bray, Gruvlok, Keystone K-ball, or Watts.
3. Check: US Valve, Metraflex, DeZurik, Victaulic, Milwaukee, Mueller, Apco, Cla-Val, Prince, or American Wheatley Products.
4. Hydronic System Pressure Reducing Valves: Cash-Acme, Cla-Val, Watts, or Wilkins.
5. Hydronic Pressure Relief Valves: Cash-Acme, Cla-Val, Watts, or Wilkins.
6. Hydronic Balancing Valves and Circuit Setters: Pro Hydronic Specialties, Griswold (Venturi with characterized ball valve only), Wheatley (Y-globe type only), Armstrong, Nibco (globe style), Victaulic/Tour & Anderson, Gruvlok, Oventrop, or Tyco-Grinnell.

E. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on the valve body.

F. Operators:

1. Provide 90-degree lever operator for ball valves.
2. Provide 90-degree locking lever operator for butterfly valves up through 5” size. For 6” size and greater, provide gear operator and handwheel.
3. Provide valve stem extension for lever-operated valves on insulated piping, so handle will clear insulation.
4. For valves sizes 2-1/2” and larger, located more than ten (10) feet from floor in equipment room areas, provide chain operated sheaves. Provide chain and extend down to five (5) feet above floor and hook clips on chain arranged to clear walking aisles.

G. Valve Features:

1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features. Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
2. Bypass: On valves 6" and larger comply with MSS SP-45, and except as otherwise indicated, provide manufacturer's standard bypass piping and valving. Provide a 3-valve bypass, minimum 1" size, to consist of two threaded shut-off valves and a plugged drain valve.
3. Drain: Comply with MSS SP-45, and provide 3/4” threaded pipe end with cap on chain.
4. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
5. Grooved: Valves shall be joined using grooved joint couplings of the same manufacturer. Copper tubing valve grooved ends shall be copper tubing sized.
6. Vic Press 304™: Valves complete with Vic Press 304™ ends.
7. Threaded: Valve ends complying with ANSI B2.1.
8. Solder-Joint: Valve ends complying with ANSI B16.18.
9. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

2.4 HVAC SERVICE VALVES: MAXIMUM 125 PSIG SYSTEM WORKING WATER PRESSURE

A. Ball Valves, 2” and Smaller:

1. 2-piece brass body, 600 psi rating, stainless steel or chrome plated brass ball, Teflon seat, brass or stainless steel stem, steel handle, full port. Threaded steel ends for iron pipe and soldered ends for copper pipe. Threaded steel pipe: Milwaukee #BA-100 or equal. Soldered copper pipe: Milwaukee #BA-150 or equal.
2. 2-piece stainless steel body, 300 psi maximum operating pressure, ASTM A-312 compliant, Vic-Press Schedule 10S ends for Type 304 stainless steel pipe, brass body, chrome plated brass ball, brass stem, PTFE seats, steel handle, full port. Victaulic Series 589 or equal.

B. Butterfly Valves, 2-1/2” and Larger:

1. 2-1/2” through 12”, lug type, MSS SP-67 compliant, 250 psi dead-end shutoff, cast or ductile iron body, stainless steel stem, EPDM seat, memory stop control, lever handle thru 5" size and worm gear operator for 6" and larger. Disc may be stainless steel,

bronze, nickel-plated ductile iron or aluminum bronze. Mount stem in horizontal position. Molded in seat acceptable in this size range. Milwaukee model ML323E, Keystone 222 or equal.

2. 14" through 48", lug type, MSS SP-67 compliant, ductile iron body, stainless steel stem, EPDM seat, memory stop control, worm gear operator. Disc may be stainless steel, bronze, nickel-plated ductile iron or aluminum bronze. Mount stem in horizontal position. Milwaukee model ML323E, Keystone GRL, or equal.
3. 2-1/2" through 12" grooved end type, MSS SP-67 compliant, ASTM A395 and A536 compliant, ductile iron body, stainless steel stem, and memory stop control. Lever handle thru 5" size and worm gear operator for 6" and larger. Disc may be nickel coated ductile iron, aluminum bronze or stainless steel. Mount stem in horizontal position. Victaulic Vic®-300 MasterSeal, Tyco Grinnell Model B302, Gruvlok FIG 7700 Series.
4. 14" through 24" grooved end type, MSS SP-67 compliant, ASTM A395 and A536 compliant, ductile iron body, EPDM seal, stainless steel stem, with gear operator. Disc may be nickel coated ductile iron, aluminum bronze or stainless steel. Mount stem in horizontal position. Victaulic Vic®-300 AGS (300 psi maximum pressure.), Tyco-Grinnell Model B308, Gruvlok FIG 7700 series.
5. 2-1/2" through 6" copper tube dimensioned grooved end type, cast brass body, EPDM seal, stainless steel stem, memory stop control, lever handle thru 5" size and worm gear operator for 6". Disc may be nickel coated ductile iron, aluminum bronze or stainless steel. Mount stem in horizontal position. Victaulic Series 608N, Tyco-Grinnell Model B680, or Gruvlok BFV.

C. Check Valves:

1. Bronze Silent Check Valves – Up to 1-1/2":

   a. Class 125, MSS SP-80, ASTM B62, ASTM B16, bronze body, threaded ends, bronze spring, Buna disk ring, and silent closing. Milwaukee #548B/548T or equal.

2. Globe Style Silent Check Valves – 2" and Larger:

   a. Class 125, MSS SP-125, ASTM A126 class B cast iron body, ASTM B584 bronze seat and plug, stainless steel spring, bronze bushing, stainless screw. ANSI B16.1 flange rating to 190 psi up to 12" and 135 psi above 12". Cla-Val Series 581, Apco Series 600, Metraflex Series CVO900 or equal.

3. Wafer Style Silent Check Valves – 2" and Larger:

   a. Class 125, MSS SP-125, ASTM A126 class B cast iron body, ASTM B584 bronze seat and disc, stainless steel spring, bronze bushing, stainless screw. ANSI B16.1 flange rating to 190 psi up to 12" and 135 psi above 12". Milwaukee Series 8800, American Wheatley Dual Disc Series, Prince Fig. 810, or US Valve Series 09.

4. Grooved Style Silent Check Valves – 2" to 12":

   a. ASTM A536 ductile iron body, single stainless steel disc, EPDM disc coating, brass or stainless steel shaft, stainless steel spring, stainless steel plug. Sizes 2" to 3" rated for 365 psi working pressure and sizes 4" to 12" rated for 300 psi working

pressure. Victaulic Series 716H/716, Gruvlok Series 7800, Grinnell Series 590 or equal.

b. Venturi style check valve with flow measuring taps across the valve. ASTM A536 ductile iron body, single stainless steel disc, EPDM disc coating, brass or stainless steel shaft, stainless steel spring, stainless steel plug. Sizes 2" to 3" rated for 365 psi working pressure and sizes 4" to 12" rated for 300 psi working pressure. Victaulic Series 779 or equal.

D. Drain Valves:

1. Threaded or soldered ends, Class 125, ASSE 1005, bronze body, screw-in bonnet, rising stem, composition disc, 3/4" hose outlet.
2. Threaded or soldered ends, Class 600, bronze body, 2-piece ball valve, 3/4" hose outlet with cap and chain. Milwaukee #BA-100/150H.

E. Gate Valves:

1. 2" and Smaller: Class 150, MSS SP-80 and ASTM B62 compliant, cast bronze body, bronze union bonnet, solid bronze wedge, rising or non-rising stem, brass packing gland, non-asbestos packing and aluminum or malleable iron hand-wheel. Threaded steel pipe: Milwaukee #1151. Soldered copper pipe: Milwaukee #1169 or equal.
2. 2-1/2" and Larger: Class 125, MSS SP-70 and ASTM A126 compliant, Grade B cast iron body, flanged ends, bolted bonnet, solid wedge, bronze trim, OS & Y, brass packing gland, non-asbestos packing and cast iron hand-wheel. Milwaukee #F-2885-M or equal.

F. Globe Valves:

1. 2" and Smaller: Class 150, MSS SP-80 and ASTM B62 compliant cast bronze body, bronze union bonnet, bronze wedge, rising stem, brass packing gland, non-asbestos packing and aluminum or malleable iron hand-wheel. Threaded steel pipe: Milwaukee #590T. Soldered copper pipe: Milwaukee #1590T or equal.
2. 2-1/2" and Larger: Class 125, MSS SP-70, ASTM A126 Grade B cast iron body, flanged ends, bolted bonnet and disc, bronze trim, OS & Y, brass packing gland, non-asbestos packing and cast iron hand-wheel. Milwaukee #F-2981-M or equal.

2.5 HVAC SERVICE VALVES: MAXIMUM 250 PSIG SYSTEM WORKING WATER PRESSURE

A. Ball Valves, 2" and smaller:

1. 3-piece carbon steel body, 1000 psig WOG rating up to 300°F, MSS SP-110 compliant, threaded ends, stainless steel ball, stainless steel stem, reinforced PTFE seat, stainless steel lever handle, full port. Milwaukee #30CSOF, Keystone K-ball Figure 120, or equal.
2. 3-piece stainless steel body, 400 psi maximum operating pressure, ASTM A-351 compliant, Vic-Press Schedule 10S ends or grooved for Type 304 stainless steel pipe, stainless steel body, stainless steel ball, stainless steel stem, PTFE seats, stainless steel handle, full port. Victaulic Series P569 or equal.

B. Butterfly Valves, 2-1/2" through 18":

1. One-piece carbon steel body, wafer or lug type, MSS SP-68 compliant, Class 300 carbon steel body, stainless steel stem, Stainless steel disc, RTFE or reinforced PTFE seat, memory stop control, lever handle thru 5" size and worm gear operator for 6" and larger. Mount stem in horizontal position. Milwaukee Series HP, Keystone K-Lok Figure 37, or equal.

C. Check Valves:

1. Bronze Silent Check Valves – Up to 1-1/2":

a. 250 psi rating, ASTM B-584 cast bronze body, threaded ends, bronze spring, Buna or TFE disk ring, and silent closing. Milwaukee #548B/548T or equal.

2. Globe Style Silent Check Valves – 2" and Larger:

a. Class 250, MSS SP-125, ASTM A126 class B cast iron body, ASTM B584 bronze seat and plug, stainless steel spring, bronze bushing, stainless screw. ANSI B16.1 flange rating to 370 psi up to 12" and 280 psi above 12". Cla-Val Series 581, Apco Series 600, Metraflex Series CVO900 or equal.

3. Wafer Style Silent Check Valves – 2" and Larger:

a. Class 250, MSS SP-125, ASTM A126 class B cast iron body, ASTM B584 bronze seat and plug, stainless steel spring, bronze bushing, stainless screw. ANSI B16.1 flange rating to 370 psi up to 12" and 280 psi above 12". Cla-Val Series 580, Metraflex Series CVO700, Milwaukee Series 1400, Hammond Series IR9253 or approved equal.

D. Gate Valves:

1. 2-1/2" through 12", Class 200, MSS SP-70, ASTM A126 Grade B cast iron body, flanged ends, OS&Y, cast iron bonnet, cast iron wedge, bronze trim, rising stem, bronze packing gland, cast iron handwheel. Milwaukee #F-2894-M or equal.
2. 14" through 24", Class 300, MSS SP-70, ASTM A126, Grade WCB cast steel body, flanged ends, OS&Y, A216 Gr WCB wedge and bonnet, rising stem, A182 Gr F6a packing gland, iron handwheel. Milwaukee #F-2894-M or equal.

E. Globe Valves:

1. 2" and Smaller: Class 200, MSS SP-80, ASTM B62 cast bronze body, bronze union bonnet, bronze wedge, rising stem, brass packing gland, non-asbestos packing and aluminum or malleable iron hand-wheel. Threaded steel pipe: Milwaukee #570 or equal.
2. 2-1/2" and Larger: Class 200, MSS SP-70, ASTM A126 Grade B cast iron body, flanged ends, bolted bonnet and disc, bronze trim, OS & Y, brass packing gland, non-asbestos packing and cast iron hand-wheel. Milwaukee #F-2983-M or equal.

2.6 BALANCING VALVES: MAXIMUM 125 PSIG SYSTEM WORKING WATER PRESSURE

A. Pressure Independent Water Flow in Variable Flow Systems:

1. 1/2" and Larger: Construction and attachment style as required by piping system. Body shall be brass, bronze, steel or ductile iron as required by valve size. Internal working parts and removable flow cartridge shall be stainless steel. Valves shall be factory set and shall automatically limit the flow to specified capacities with 10% +/- accuracy over the entire operating pressure differential. Pressure and temperature ports shall be extended to outside of insulation. The permanent pressure lost added to the pump head shall not exceed three (3) psi.
2. Manufacturers: Pro Hydronics Specialties, Griswold, Victaulic, Danfoss, IMI Flow Design AutoFlow, Oventrop, Hays Fluid Controls, or approved equal.

B. Pressure Dependent Water Flow in Constant Flow Systems:

1. 1/2" and Larger: Construction and attachment style as required by piping system. Body shall be brass, bronze, steel or ductile iron as required by valve size. Characterized ball valve or Y-type globe valve design with memory stop. Valves shall be field adjustable. Pressure and temperature ports shall be extended to outside of insulation. Install in pipe with minimum length of unrestricted straight pipe equivalent to five pipe diameters upstream and two pipe diameters downstream.
2. Manufacturers: ManPro Hydronics Specialties, Hays Fluid Controls Venturi (insert/ball valve style), Preso Venturi B-Plus series, Oventrop Hydrocontrol R,F, and G, Griswold (Venturi with characterized ball valve only), IMI Flow Design FlowSet, Wheatley (Y-globe type only), Armstrong, Nibco (Globe style), Tyco-Grinnell, Oventrop, or Victaulic/Tour & Anderson or Gruvlok(Y-globe type only), Series 786 (soldered), Series 787 (threaded), Series 788 (flanged or Series 789 (grooved), or approved equal.

2.7 TERMINAL UNIT ASSEMBLIES – COIL KITS

A. General: As an alternative to built-up valve and connection assemblies for terminal units, a complete kit consisting of valves, strainer, balancing, and flexible hose connection may be provided. Pro Hydronic Specialties, Victaulic Koil Kit Series 799 or 79V, Hays Fluid Controls, or equal by others.

2.8 BRANCH CIRCUIT DIFFERENTIAL PRESSURE CONTROL VALVES

A. Self powered control valves designed to maintain constant differential pressure for branch circuits and consisting of a differential control, single pressure temperature port, and dead end service shutoff. Shall be capable of stabilizing pressure ranges of 1.5 to 8.7 psi in 3/4" to 1" valves, 2.9 to 11.6 psi in 1-1/4" -2" valves, or 51 psi for 2-1/2" through 4" valves.

B. Bonnet shall be manufactured of copper alloy, O-rings, seat seal, and membrane to be EPDM.

C. T/A 793/794 used in conjunction with Victaulic T/A balancing valves.

2.9 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES (COIL CONTROL VALVES)

A. Modulating control valves shall be pressure independent characterized two-way actuated flow control valves. The flow rate through the valve shall not vary more than + or - 15% due to system pressure fluctuations across the valve in the selected operating range.

B. Electronic valves at all variable air volume terminals, constant volume terminals, fan powered terminals, and zone reheat coils with valve connections of 1" (18 gpm) or less in size may

utilize floating point control. All air handler coils shall utilize proportional control electronic valves.

C. The rangeability of the valve shall be 90:1 (minimum).

D. The valve bodies shall be of cast brass and rated for 200 PSI working pressure (minimum). All internal parts shall be stainless steel, teflon, brass, bronze, or polyphenylsufone orifice with an elastomeric diaphragm. The valves shall be serviceable without removing them from the piping system. Valve flow characteristics shall be able to be changed without removing the valve from the piping system.

E. Balancing valves shall not be required where these control valves are installed. Flow performance curves shall be provided with each valve

F. The actuator shall modulate the control valve from 0 to 100% design flow. The actuator shall be directly coupled to the valve at the factory.

G. Pressure/temperature ports (Pete's Plugs) shall be installed at the factory in each valve larger than 1" or be integral to the valve. Two ports shall be used to measure inlet and outlet pressure to the valve.

H. Manufacturer: Honeywell VRN, Belimo PICCV, Hays Fluid Controls, Victaulic TCP Series, Danfoss AB-QM, Griswold PIC-V, MVP, or PIM models, Oventrop Cocon Q or Flow Control Industries DeltaPValve. Valves shall be provided by controls provider and installed by piping.

2.10 HYDRONIC SYSTEM PRESSURE REDUCING VALVES

A. Single seated, direct operated type; high capacity, having bronze body with strainer, by-pass feature, pressure gauge tappings and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and fall-off at inlet and outlet pressure indicated.

1. 25-75 psig range: Watts #U5 series.
2. 10-25 psig range: Watts #N256
3. Provide with asbestos-free insulating cover, with silicone treated fiberglass cover, 1" insulation, and Velcro fasteners. Suitable for temperatures up to 550 deg. F.
4. Spence #Series E or equal.

2.11 HYDRONIC SYSTEM THREE-WAY THERMOSTATIC VALVES

A. Self-regulating three-way thermostatic valves to be used in mixing applications with non-condensing type boilers to maintain minimum heating water return temperature above condensing. Valve requires no power or control connections.

B. Valve shall use self-contained wax element selected at 135°F. Valve shall close the bypass port when the return water temperature exceeds 135°F. The self-contained element shall activate a stainless steel sleeve to direct the flow. The thermostatic elements are factory set and non-adjustable. In a mixing application the hot water supply from the boiler enters the "B" port and hot water return fluid from the building enters the "C" port. The flows mix and the thermostat adjusts the valve to reach the desired temperature at the exiting "A" port. When the exiting temperature at "A" port exceeds 135°F the port "B" shall be closed and full flow will be routed through port "C".

C. Sizes

1. 3/4” to 2”: Ductile iron, steel or stainless steel body rated at no less than 150 PSI, NPT threaded.
2. 2-1/2” to 6”: Ductile iron, steel or stainless steel body rated at no less than 150 PSI, flanged. Coordinate with pipe flanges for full face or raised face flanges.

D. Manufacturer: Fluid Power Energy Thermostatic Control Valves models 0750 through 6010, Oventrop TriD, or equal.

2.12 HYDRONIC SYSTEM PRESSURE RELIEF VALVES

A. Pressure Relief Valves: Constructed in accordance with ASME, 125-pound setting, and so stamped. Size as required. Watts #740 Series.

B. Temperature and Pressure Relief Valve: Constructed in accordance with ASME, 125-pound setting (or pressure setting as indicated on construction documents), and so stamped. Size as required. Watts #100XL, 40XL, 140, N240, or 340 Series.

2.13 HYDRONIC SYSTEM REDUCED PRESSURE BACKFLOW PREVENTION VALVES

A. General: All backflow prevention valves shall be State approved. Coordinate with plumbing system for provision of domestic water to reduced pressure backflow prevention to protect domestic water system from connection to hydronic piping systems.

B. Reduced Pressure Backflow Preventer

1. 2" and Smaller: Assembly shall consist of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1013 and AWWA C506. Bronze construction, threaded ends, stainless steel internal parts, and air gap fitting. Route pipe from air gap fitting to approved waste receptor. Watts #909-QT-S-HW valve with #909AG air gap fitting.
2. 2-1/2" and Larger: Assembly shall consist of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1015 and AWWA C506. Epoxy coated cast iron body construction, flanged ends, stainless steel internal parts, bronze seats, and air gap fitting. Route pipe from air gap fitting to approved waste receptor. Watts #909-S-OSY valve with #909AG air gap fitting.

2.14 AIR ELIMINATION VALVE (AUTOMATIC)

A. Air shall be eliminated to the atmosphere as fast as it is separated from system water, through a float activated remote pressure operated, air elimination valve installed at the top of the air separator.

B. The air elimination valve shall have a high removal rate at low pressure differentials and shall be fully open for the removal of air at all pressures in the operating range from 2 to 150 psig. It shall be tightly sealed against loss of system water and prevent entrance of air in negative pressure situations.

C. The air elimination valve shall be constructed of metal and all working parts shall be non-corrosive. Working pressure shall be 125 psi.

D. Provide minimum 3/8” drain line from vent and route to nearest floor drain or floor sink or other approved drainage location.

E. Manufacturer: Amtrol, Hoffman, or equal.

2.15 THERMOMETERS AND GAUGES

A. General:

1. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.
2. No mercury shall be used in thermometers due to hazardous material classification.
3. Acceptable Manufacturers: Weklser, Ashcroft, Trerice, Marshalltown, WIKA or US Gauge.

B. Thermometers:

1. Bi-Metal Type: Provide bi-metal glass thermometers of materials, capacities, and ranges indicated, designed and constructed in service indicated. Accuracy shall be 1% +/- full scale with adjustable recalibration.

    a. Case: Type 300 series stainless steel, hermetically sealed, glass window, 3" diameter dial, with adjustable angle.
    b. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.
    c. Scale: Satin faced, non-reflective aluminum, permanently etched markings.
    d. Stem: Stainless steel, adjustable angle socket, length to suit installation.

2. Glass Thermometer: Provide adjustable angle 9” thermometer of materials, capacities and ranges as appropriate to medium being measured and designed and constructed for service indicated. Accuracy to be 1% +/- of full scale.

    a. Case: Aluminum or Valox
    b. Temperature Sensitive Gage Liquid: Organic non-toxic. No mercury permitted.
    c. Scale: Aluminum painted white with black markings.
    d. Connection: 1/2” NPT with thermowell, 1-1/4” UNF swivel nut without thermowell.

3. Photovoltaic Cell Powered LCD Thermometer

    a. Case: ABS Plastic
    b. Accuracy: 1% of full scale
    c. Display: 16 LUX rating LCD display. Switchable Fahrenheit and Celcius.
    d. Connection: 3/4” NPT with thermowell 1-1/4” UNF swivel nut without thermowell.

4. Range: Conform to the following:

    a. Hot Water: 20°F - 240°F with 2°F scale divisions.
    b. Cold Water: -40°F - 160°F with 2°F scale divisions.

C. Sensor Test Wells:

1. Provide control device test wells as indicated and as required by the BAS. Constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 3" extension for insulated piping. Provide shutoff valves to isolate sensor for maintenance and removal.

D. Thermometer Test Wells:

1. Provide 1/4” thermometer test wells as indicated and as required by the BAS. Constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 3” extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

E. Temperature/Pressure Gauge Connector Test Plugs (Pete’s Plugs):

1. Provide temperature gauge connector plugs pressure rated for 500 psi and 200° F (93° C). Construct of brass or stainless steel, equip with 1/2” NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8” O.D. probe assembly from dial type insertion thermometer or pressure gauge. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

F. 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 bourbon type, bottom connection.
3. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.
4. Connector: Brass with 1/4" male NPT.
5. Scale: White coated aluminum, with permanently etched markings.
6. Pressure differential range shall be 100 psig minimum for the appropriate application with maximum 1 psig divisions.

G. Pressure Gauge Cocks:

1. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Gauge cock shall be 1/4-1/2” threaded end, 2-piece bronze body ball valve. Milwaukee #BA-100.
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.

2.16 PIPING SPECIALTIES

A. General:

1. Provide factory fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and

equipment connections. Where more than one type is indicated, selection is installer's option.

B. Pipe Escutcheons:

1. Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas.
2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged.
3. Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged.

C. Low Pressure Y-Type Pipeline Strainers:

1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 150% (minimum) of the working pressure of piping system
2. Threaded Ends, 2" and Smaller: Cast-iron body, conforming to ASTM A126, screwed screen retainer with centered blowdown fitted with hose bibb. Manufacturer: Spirax Sarco, Keckley, Wheatley, Mueller, or equal.
3. Flanged Ends, 2-1/2" and Larger: Cast-iron body, conforming to ASTM A126, bolted screen retainer with off-center blowdown fitted with 3/4” drain valve. Manufacturer: Spirax Sarco, Keckley, Wheatley, Mueller, or equal.
4. Grooved Ends, 2-1/2” and Larger: Ductile iron body, conforming to ASTM A395 and ASTM A536, bolted screen strainer with off center blowdown fitted with 3/4” drain valve. Manufacturer: Victaulic style 730/731/732, Tyco-Grinnell Fig. S853 and S55, Gruvlok FIG 7260/758G, or equal.
5. Strainer screen or basket, Type 304 stainless steel or better.

    a. Start-up screen for first month of operation shall be a 40 mesh with 0.016” openings and 41% open area. For applications with piping connected to existing piping systems the start-up screen shall be 60 mesh with 0.010” openings and 38% open area.
    b. Start-up screen shall be removed and replaced with normal operation screen after one month of pump operation, or as directed by the water treatment company, and prior to final water balance.
    c. Normal operation screens or baskets, shall be installed prior to final water balance.
        1) Strainer sizes up to 2” shall be provided with 20 mesh screens, with 0.035” openings and 49% open area (minimum).
        2) Strainer sizes 2-1/2” and larger shall be provided with perforated baskets with 3/64” diameter perforations with 36% open area (minimum).

D. Drip Pans:

1. Provide drip pans fabricated from 20-gauge galvanized sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top by structural angles. Provide hole, gasket, and flange at low point for watertight joint and 1" copper drain line connection.

E. Air Vent with Valves:

1. Install in all closed and open loop water systems at high points of systems and at any other point necessary to free system of air. A shut-off valve shall be provided in riser to each automatic vent valve to facilitate servicing. A minimum 3/8" type "L" copper tubing drain line shall be run to floor sink, floor drain or other approved drain receptacle to carry away water that valve discharges. Manual type vent may be used in lieu of automatic type, where specifically shown on the Drawings. Provide Hoffman #79 or equal by Amtrol, Watts, or Dole.

F. Dielectric Waterways:

1. To effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.
2. Steel to copper, with thermoplastic dielectric lining.
3. 250 psig rated pressure at 210°F.
4. Connection: screwed, grooved, sweat, or flanged to match pipe.
5. Victaulic style 47, Gruvlok FIG 7088/7089 or equal.

G. Dielectric Flanges: Provide dielectric flanges and dielectric bolt sleeves for flanged transitions between dissimilar metal piping. Watts Series 3100 or approved equal.

H. Unions:

1. Unions shall be of type specified in following schedule:

   a. Black Steel, 2" and smaller: 250 lb. screwed malleable iron, ground joint, brass to iron seat.
   b. Black Steel, 2-1/2" and larger: 150 lb. cast iron screwed flanged, flat faced, full faced gasket.
   c. Stainless Steel, 2" and smaller: 300 psi maximum operating pressure, threaded union, with Vic Press 304™ ends.
   d. Soldered Copper or Brass Pipe, 2" and smaller: 150 lb. cast bronze or copper, ground joint, non-ferrous seat with soldered ends.
   e. Screwed Copper or Brass Pipe, 2" and smaller: 150 lb. cast brass, ground joint, brass to brass seat, with threaded ends.
   f. Flanged Copper or Brass Pipe, 2-1/2" and larger: two (2) 150 lb. cast bronze flanges.
   g. Where grooved joint piping systems are utilized, unions are not required. Grooved joint couplings shall serve as unions.
   h. Manufacturer: EPCO, Mueller, Stanley G. Flagg, Victaulic, Tyco-Grinnell, or Watts.

I. Flanges:

1. Provide flanges at flanged connections to equipment, tanks and valves. Faces of flanges being connected shall be alike in all cases. Connection of raised-face flange to flat-faced flange not permitted.
2. Use ASTM A307, Grade B, bolts and nuts for cast iron flanges and ASTM A193 for steel flanges. Regular square head unfinished bolts with heavy semi-finished hex nuts ASTM

A194. Cadmium plated where exposed to weather. Rating: 150 lb. or 300 lb. in high pressure portions.

3. Type of pipe and corresponding flanges as follows:

    a. Screwed Black Steel Pipelines: 125 lb. black cast iron screwed flange, flat faces.
    b. Stainless Steel Pipe, Class 150 stainless steel flange adapter with carbon steel back-up flange and Vic Press 304™ end.
    c. Welded Steel Pipe, 150 lb. black forged steel welding flanges, 1/16" raised face ASTM A181 Grade I. Use flat face when connected to flat faced companion flange.
    d. Grooved Steel Pipe, Class 150, ASTM A395 and A536 ductile iron flange adapter, with pressure responsive synthetic rubber gasket. Victaulic Style 741, Tyco-Grinnell Fig. 71, or Gruvlok FIG 7401.

J. Flange Gaskets:

1. Type: full faced or flat ring to suit flange facings.
2. Shall conform to ASTM F-104
3. Minimum thickness: 1/16”
4. Manufacturer: Garlock style 3200, or approved equal.

K. Pipe Sleeves:

1. Provide fire proof sleeve assemblies utilizing UL rated sealant systems at all fire rated penetrations. For non-rated sleeve penetrations pack the annular space between the pipe and sleeve with fiberglass and/or mastic.
2. Sleeves shall provide a minimum ½ inch annular clearance around pipe.
3. Sheet metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3" and smaller, 20 gauge; 4" to 6", 16 gauge; over 6", 14 gauge.
4. Steel pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
5. Iron pipe: Fabricate from cast iron or ductile-iron pipe; remove burrs.
6. Plastic and copper pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.
7. Sleeves through interior concrete walls and floors: Telescopic, submerged, adjustable sleeves by Adjust-to-Crete, AMI or Shamrock. Floor sleeves to extend a minimum of 1” above finished floor.
8. Through exterior walls and floor on grade: 150-pound class cast-iron pipe sleeve. Where waterproof membranes are used, provide membrane clamps. For insulated piping, sleeve diameter shall not be less than diameter of insulated pipe.
9. Cast-in-place watertight device for protecting penetrating objects from expansion and contraction of concrete. Factory-assembled for use in cast-in-place concrete floors and walls and consisting of two outer sleeves and a one-piece radial extended-flange waterstop gasket, with mid-body seal for embedment and sealing to concrete slab and continuous water seal extending to the penetrating pipe.

    a. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE, Hydro Preseal, or equal.
    b. Outer Sleeves: EPDM or NBR attached to the mid-body seal forming an area with which to attach the device to the structural reinforcing rod determining the position of sleeve in the wall.

c. Water Stop Mid-body Seal: Flexible polymer seal with radial extended flange consisting of one to three concentric raised rings which lock into concrete, maintaining seal over time as concrete contracts from sleeve. <Describe size and type of pipe to be inserted in sleeve seal>.

L. Sleeve Seals:

1. All sleeves shall be sealed to prevent intrusion of moisture, dust or insects.
2. Underground: For sleeves passing through exterior or foundation walls, provide mechanical link seal assembly.
3. Aboveground: For sleeves passing through walls or floors provide a non-toxic 3-hour rated fire resistant silicone foam sealant with a Flame Spread Rating of 20. Sealant to be tested and approved under UL 263, ASTM E119, and NFPA 251 Standards. All fire rated penetrations shall be sealed with approved UL System.
4. Local Approvals: All seals to be provided shall be in accordance with the regulations of all governing agencies of the city, county, and State Fire Marshal's Office.

M. Watertight Sleeve-Seal Systems

1. Wood Decking Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.

    a. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE, Hydroflame Sleeve, or equal.
    b. Consists of an outer sleeve lined with an intumescent strip, and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork.
    c. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab.
    d. Retain subparagraph below if fire resistance rating is required.
    e. Provide a one-hour, two-hour, or three-hour fire-resistance rated assembly as required at penetration when tested according to ASTM E 814 or ANSI/UL 1479.

2. Metal Decking Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in floors formed with steel decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, hot gasses and fire.

    a. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE, Hydroflame CMD Metal Deck Device, or equal.
    b. Consists of an outer sleeve lined with an intumescent strip, and wide outside wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.
    c. Includes a cone attached to the base for extending the device through the metal deck and a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab.
    d. Retain subparagraph below if fire resistance rating is required.

e. Provide a one-hour, two-hour, or three-hour fire-resistance rated assembly as required at penetration when tested according to ASTM E 814 or ANSI/UL 1479.

2.17 EXPANSION COMPENSATORS AND FLEXIBLE PIPING CONNECTIONS

A. General: Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. All piping mains, branches and runouts shall be installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Stresses shall be within allowable limits of ANSI B31.1 for pressure piping. Vertical piping for chilled water, heating water, and condenser water shall be provided with system flexibility to allow expansion compensation at each floor level without inducing stresses on branch piping. Expansion products to conform to the standards of the Expansion Joint Manufacturer's Association. Expansion joints shall not require packing. Installer shall select materials and pressure/temperature ratings to suit intended service. Select packless expansion joints to provide 150% absorption capacity of calculated maximum piping expansion between anchors. All connections shall have ends to match piping system application.

B. Expansion Compensators (Pipe Compression and Extension): Multiple stainless steel bellows and stainless steel liner with shroud and end fittings. Keflex #311 series or approved equal.

C. Flexible Expansion Joint/Seismic Connector for Steel Pipe: Stainless steel hose and braid, 180° return, CSA approved, and end fittings. Metraflex #Metraloop, Unisource V-SF21 Style, or approved equal.

D. Flexible Connection for Steel Pipe (piping and equipment located outside the building): Stainless steel hose and braid, with threaded or flanged ends. Metraflex #SST or approved equal. Provide steel supports to prevent sagging is required.

E. Three grooved joint flexible type, not rigid, couplings may be used in lieu of flexible connectors on steel pipe for vibration attenuation and stress relief. Grooved joint couplings shall be placed in close proximity to the vibration source. For services up to 250°F. Victaulic Style 177 or 77, Tyco Grinnell Fig. 705 and 707 couplings, or Gruvlok FIG 7401.

F. Flexible Connection for Copper Pipe: Bronze hose and braid, copper tube ends. Metraflex #BBS, Unisource V-BF11 Style, or approved equal. Provide steel supports to prevent sagging is required.

G. Flexible Rubber Connectors (Pump Connections): Concentric spool type expansion joint, single or double arch. Chlorobutyl tube and cover, meeting ASTM specification D2000 Grade 2AA610AB, L13. The body shall be reinforced with rectangular body rings and a minimum of six bias plies of polyester fabric. A hypolon coating shall be applied completely and uniformly to the cover. All expansion joints shall be rated 190 PSI/26 inch vacuum at 250° F for sizes up to and including 12 inch.

1. For heating hot water service and critical pump connections. Furnish with fluorelastomer tube and cover to ASTM D2000 Grade 1HK710. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/kevlar fabric rated 190#/26 inch vacuum at 400° F. Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension. Manufacturer shall provide documentation utilizing oven aged and cold flexibility tests to verify elastomer capability. Each batch of compound manufactured shall be tested to verify it conforms to the ASTM specifications listed below. Garlock #204HP. No known equals.

	CHLOROBUTYL	VITON
Specific Gravity	ASTMD 792	ASTMD 792
Durometer Shore A	ASTMD 2240	ASTMD 2240
Tensile	ASTMD 412	ASTMD 412
Elongation	ASTMD 412	ASTMD 412

	POLYESTER	FIBERGLASS/KEVLAR
Thread Count	ASTMD 3775	ASTM 1910
Gauge	ASTMD 1777	ASTMD 1777
Weight	ASTMD 3776	ASTM 1910
Breaking Strength	ASTMD 1682	ASTMD 1682

2. For chilled water, condenser water, and non-critical pump connections. Furnish with fluorelastomer tube and cover to ASTM D2000 Grade 1HK710. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/kevlar fabric rated 190#/26 inch vacuum at 250° F. Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension. Garlock #206 EZ-FLO or equal.
3. Three grooved joint flexible type couplings may be used in lieu of flexible connectors on steel pipe for vibration attenuation and stress relief. Grooved joint couplings shall be placed in close proximity to the vibration source. For services up to 250°F. Victaulic Style 177 or 77 or Gruvlok FIG 7401.

H. Expansion Joints for Grooved Piping: For piping systems fabricated from grooved pipe and couplings, use one of the following methods for expansion compensation:

1. Combination Couplings and Nipples: Provide expansion joints constructed of grooved short pipe nipples and flexible couplings, designed by manufacturer to suit intended service. Provide removable ties to hold joint compressed or expanded during piping fabrication, depending on application. Total joint end movement is dependent on the number of couplings/nipples in the joint. Select couplings and gasket materials to match balance of piping system. Victaulic Series 155 or Gruvlok FIG 7240.
2. Slip-Type Expansion Joints: Provide slip-type expansion joints constructed of carbon steel pipe and couplings, designed by manufacturer to suit intended service. Joint shall be gasketed expansion joint, with grooved ends. Slide section coated with PTFE modified PPS (Polyphenylene Sulfide) coating. Joint suitable for axial end movement up to 3". Victaulic Style 150. Select couplings and gasket material to match balance of piping system.
3. Three flexible couplings: Use three flexible couplings (Victaulic 177, 75 or 77, Tyco-Grinnell Fig. 705 and 707, or Gruvlok FIG 7401) for the first three connections in close proximity to a pump or chiller to eliminate flexible rubber connectors.

I. Pipe Alignment Guides: Provide pipe alignment guides on both sides of expansion joints, and elsewhere as indicated on drawings. Guide shall be of carbon steel construction with split guiding cylinder and integral anchor base and internal four finger two-piece spider. Cylinder wall thickness shall be equal to schedule 40 wall thickness of pipe being guided. Spider shall be capable of clamping directly to pipe and moving only in an axial direction while inside cylinder. Anchoring directly to building substrate. Metraflex #Style IV or equal.

J. Expansion Loops: Provide field fabricated pipe expansion loops as detailed on the drawings or in place of mechanical expansion joints. Expansion loops in IPS steel and roll grooved copper tubing systems shall be accommodated with loops or bends consisting of eight (8) mechanical groove-type couplings, four (4) 90-degree elbows, and three (3) grooved end pipe spools provided in water systems up to 250°F in accordance with recommendations for expansion compensation.

2.18 PIPE COATING

A. All exposed above ground steel and copper pipe and fittings in corrosive air environments shall be covered with one of the following methods:

1. Twice Wrap 20 Mill Scotch Wrap PVC No. 51, 50% overlap.
2. Prefabricated extruded plastic cover with joints sealed with two coats of 20 Mill Scotch Wrap No. 51.

2.19 SUPPORTS AND ANCHORS (SEE SECTION 230500)

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal or otherwise irregular work unless so indicated on Drawings or approved by the Owner's Representative.

C. Coordinate mounting and attachment of tanks with Structural Engineering design.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturer's directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.3 INSTALLATION

A. Coordinate the work between the various Mechanical Sections and with the work specified under other Divisions of the work or contracts toward rapid completion of the entire project. If any cooperative work must be altered due to lack of proper supervision or failure to make proper provisions in time, then the work hereunder shall include all expenses of such changes as are necessary in the work under other contracts, and such changes shall be directly supervised by and made to the satisfaction of the Owner's Representative.

B. The cooperative work not included in the Mechanical Division related to the general construction work is as follows:

1. All formed concrete work
2. Framed openings in masonry and other Architectural and Structural elements
3. Wood grounds and nailing strips in masonry and concrete

C. Inspect all material, equipment, and apparatus upon delivery and do not install any that may be subject to rejection as a result of damage or other defects. Provide tarps and visqueen cover to protect equipment and piping delivered to and stored at the site.

3.4 WORKING PRESSURES

A. All fittings, valves, pipe, specialties equipment shall be rated for the working pressure subjected in the installed locations.

B. Drawings indicate working pressure in each system. The rating of the equipment and material shall not be less than that of the system pressures.

3.5 PIPE SIZES TO EQUIPMENT

A. General: Pipe sizes indicated on drawings shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of equipment.

B. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valve.

3.6 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints or couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16 inch misalignment tolerance. Comply with ASME B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2 inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1 inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

C. Elevator Machine Rooms, Switchgear, Generator, Telecommunications, Telephone Rooms, and Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

D. Cleaning: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any).

3.7 SLOPING, AIR VENTING, AND DRAINING

A. Water:

1. Slope all piping to allow for drainage at low points. Slope shall not be less than 1% in the direction of flow. Provide drain valves and hose adapters at all low points in piping.
2. Connect all water branch piping to the bottom or side of their respective mains. Where connection must be made to the top of the main piping, make provision for venting of air.
3. Provide manual or automatic vents at all high points in water piping and where shown on the drawings.

3.8 WELDING

A. Qualifications of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators". Installation shall conform to ANSI 31.1 "Power Piping". Welders shall be tested and certified for all positions.

3.9 PIPING SYSTEM JOINTS

A. All piping shall be cut squarely, free of rough edges and reamed to full bore. Piping shall be mechanically cleaned prior to make-up of joints and fully inserted into fittings.

B. Provide joints of type indicated in each piping system.

C. Piping shall be capped during construction to prevent entry of foreign material.

D. Thread pipe in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM. B-32, in accordance with IAPMO IS 3-93, ASTM B-828 and Copper Development Association recommended procedures. Joints shall be cleaned by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes shall be applied liberally to the outside of the pipe and the solder cup of the fitting. Fluxes shall be water soluble for copper and brass potable water applications, and shall meet CDA standard test method 1.0 and ASTM B813-91. Solder shall be applied until a full fillet is present around the joint. Solder and flux shall not be applied in such excessive quantities as to run down interior of pipe. Lead solder or corrosive flux shall not be present at the jobsite.

1. Manufacturers:

a. Solder: JW Harris "Bridgit" or Englehard "Silvabrite 100".
b. Flux: Laco "Flux-Rite 90", MW Dunton "Nokorode CDA Flux", Hercules "Fluid Action Solder Flux".

F. Braze copper tube and fitting socket or extrude joints (T-drill) with BCUP series filler metal without flux. Listed brazing flux shall be used for joining of copper tube to brass or bronze fittings and shall meet AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet shall be visible around the completed joint. After cooling, flux residue shall be thoroughly removed with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10% nickel.

G. Weld pipe joints in accordance with recognized industry practice and as follows:

1. Weld pipe joints only when ambient temperature is above 0°F.
2. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
3. Use pipe clamps or tack-weld joints with 1” long welds, 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and at edges of each weld. Weld by procedures which will ensure elimination of unsound or un-fused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.
5. Do not weld out piping system imperfections by tack-welding procedures. Re-fabricate to comply with requirements.
6. With engineering pre-approval stub-in saddle taps may be acceptable for branch connections where the branch size is less than 50% of the main size and where branch sizes are 2”, or smaller, in diameter.

H. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

I. Grooved Joints:

1. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall meet AWWA C-606 requirements.
2. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer.
3. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
4. Grooved coupling manufacturer’s factory trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

J. Adhesive Bonded Joints: All joints installed or constructed in the field shall be assembled by employees of the contractor who have been trained and certified to the bonding procedure specification provided by the pipe manufacturer. This specification shall meet or exceed the requirements of ASME B31.3, Section A328.2.1. The pipe manufacturer or their authorized representative shall train the contractor’s employees in the proper joining and assembly procedures required for the project including hand-on participation by the contractor’s employees in accordance with the manufacturer’s specification.

K. Vic-Press 304™ Joints: Pipe shall be certified for use with the Vic Press 304™ system. Pipe shall be square cut, +/- 0.030", properly deburred and cleaned. Pipe ends shall be marked at the required location, using a manufacturer-supplied gauge, to ensure full insertion into the coupling or fitting during assembly. Use a Victaulic 'PFT' series tool with the proper sized jaw for pressing.

3.10 VALVES

A. General: Except as otherwise indicated, comply with the following requirements.

1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping, strainers and other equipment. Locate valves so as to be accessible and so that separate support can be provided as necessary.
2. Install valves, except butterfly valves, with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane without prior written approval. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
3. Install butterfly valves with stems mounted horizontally.
4. All valves mounted higher than 10 feet above floor in mechanical rooms and where indicated shall be installed with stem horizontal and equipped with chain wheels and chains extending to 5 feet above floor.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends of types of pipe/tube connections:

1. Copper Pipe, 2-1/2" and Smaller:

    a. Soldered-joint valves
    b. Grooved-joint valves

2. Copper Pipe, 2-1/2" and Larger: Grooved-joint valves.
3. Stainless Steel Pipe, 2" and Smaller: Vic Press 304™ joint valves.
4. Steel Pipe, 2" and Smaller: Threaded joint valves.
5. Steel Pipe, sizes 2-1/2" and larger: One of the following, at installer's option:

    a. Flanged valves
    b. Lug valves
    c. Grooved-end valves

D. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

E. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

F. Fluid Control: Except as otherwise indicated, install gate, globe, ball, plug, circuit setter, glove, and butterfly valves to comply with ASME B31.9.

G. Check Valves: Install in vertical or horizontal a minimum of three (3) pipe diameters downstream of pump outlet.

H. Wafer Style Silent Check Valve: Install between two (2) flanges and use full size bolts to assure center alignment.

I. Ball Valve: Ball valve used on gas systems shall be UL listed, CSA approved for pressure of system, no exception

J. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

K. Valve Identification: Tag each valve in accordance with "Mechanical Identification" section.

L. Cleaning: Clean factory-finished surfaces. Repair marred or scratched surfaces with manufacturer's touch-up paint.

M. Install so handles are readily available. Locate valves and valve handles for appropriate maintenance access.

N. Gasket and O Ring Material: Valve manufacturer is responsible for submittals. Provide gasket and O ring material best suited for the both piping systems.

3.11 TEMPERATURE GAUGES

A. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor without supplemental illumination. All gages to be installed with snubbers to absorb system shock.

3.12 PRESSURE GAUGES

A. General: Install pressure gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor without supplemental illumination. All gages to be installed with snubbers to absorb system shock.

3.13 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1” minimum annular clear space between piping/insulated piping and concrete slabs and walls.

1. Retain subparagraph below when cast-in-place watertight sleeve seals are required.
2. When cast-in-place watertight sleeve seals are required, select sleeve size to match the size and type of pipe to be installed.
3. Retain subparagraph below if applicable.
4. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2” above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
4. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."Exception: When fire-resistance-rated cast-in-place watertight sleeve seals are required for floor penetrations, additional firestopping is not necessary.

3.14 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

C. Aboveground, Cast-in-Place Watertight Sleeves. Select sleeve size based on pipe size and material to be inserted, and thickness of wall.

1. Install cast-in-place watertight sleeves for pipes NPS 6 (DN 150) and smaller in diameter.
2. Position cast-in-place water tight sleeve in wall space securing sleeve to reinforcing steel using tie wire.

D. Underground, Exterior-Wall, Cast-in-Place Watertight Penetrations. Select sleeve size based on pipe size and material to be inserted, and thickness of wall.

1. Install cast-in-place watertight sleeves for pipes NPS 6 (DN 150) and smaller in diameter.
2. Secure sleeve to the reinforcing steel using tie wire.

E. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form using nails or staples. Place concrete, and finish even with top of sleeve.

3.15 EXPANSION LOOPS

A. Expansion Loops: Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by installer for adequate expansion of installed piping system. Subject loop to

cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by installer to properly anchor piping in relationship to expansion loops.

B. Expansion Compensation for Risers and Terminals: Install connection between piping mains and risers with at least five pipe fittings including tee in main. Install connections between piping risers and terminal units with at least four pipe fittings including tee in riser.

3.16 EXPANSION COMPENSATORS

A. Install as noted on plans. Where plans do not indicate spacing of guides or other pertinent information, install per manufacturer's recommendations.

3.17 PIPE INSPECTIONS

A. It is the intent of the Contract Documents that systems be inspected at completion of each phase while under tests required for administrative authorities, and prior to concealment, i.e. "Rough-in" "Top-out" and final.

B. Inspection - Below Grade: All piping installed below grade shall be inspected prior to burial by the Owner's Representative. Provide photographs of underground piping in Operation and Maintenance Manuals including location and depth of pipes. Contractor must notify the Owner's Representative no less than 24 working hours prior to inspection time. Should the piping be buried without approval the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

C. Inspection - Above Grade: All piping installed above grade shall be inspected upon completion and prior to finish of walls and ceilings by the Owner's Representative. Contractor must notify the Owner's Representative no less than 24 working hours prior to inspection time. Should the piping be hidden within the structure prior to inspection approval the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

3.18 IDENTIFICATION MARKERS (SEE SECTION 230500)

3.19 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Testing shall be witnessed by an independent third party inspector. Upon completion of testing, certify to the Owner's Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by third party inspector.

B. Piping: Remove from the system, during testing, all equipment which would be damaged by test pressure. Replace removed equipment when testing has been accomplished. The systems may be tested in sections as the work progresses; however, any previously tested portion shall become a part of any latter test of a composite system. Correct leaks by remaking joints with new material.

C. Test time will be accrued only while full test pressure is on the system, unless indicated otherwise. "Tolerance" shall be no pressure drop, except that due to temperature change in a 24-hour period. Inspect and test all work prior to burying or concealing. Test pressure shall be

the minimum test pressure listed below or 1.5 times the system operating pressure, whichever is greater. If approved by the local Authority Having Jurisdiction, the maximum test pressure may limited to 50 psi greater than the operating pressure, but in no case less than the minimum pressure listed below. Test pressure shall be applied and measured at the lowest floor level of the piping system. Confirm maximum pressure testing requirements with pipe manufacturer and do not exceed the maximum pressure rating of the piping.

SYSTEM	TEST MEDIUM	TEST PRESSURE (MINIMUM)	TOLERANCE – TEST PERIOD
Heating Water	Water	100 psig	None - 8 hours

D. Valves: Test all valve bonnets for tightness. Test operate all valves at least once from closed-to-open-to-closed position while valve is under test pressure. Test all automatic valves, including solenoid valves, and temperature and pressure relief valves, safety valves, and temperature and pressure relief valves not less than three (3) times.

E. Piping Specialties: Test all thermometers, pressure gauges, and water meters for accurate indication; automatic water feeders, and air vents for proper performance. Test all air vent points to ensure that all air has been vented.

3.20 ANTIFREEZE CHARGED PIPING

A. Where indicated on plans or schedules or other specification sections charge piping with antifreeze solution coordinated to provide freeze protection to 10°F below the ASHRAE 99.6 heating dry bulb temperature (Freeze Protection Design Temperature).

Freeze Protection Design Temperature	Freeze Protection (% Propylene Glycol)	Burst Protection (% Propylene Glycol)
20	18	12
10	29	20
0	36	24
-10	42	28
-20	46	30

B. Unless otherwise specified, provide percent of fluid by volume of inhibited propylene glycol.

C. Provide charging valves, drains, vents, and other hardware as necessary to charge the solution into the piping system.

D. Provide a calculation sheet indicating system volume in gallons and amount of glycol required.

E. Provide a post charging test of the percent of glycol and submit results for review by the Owner's Representative.

F. Manufacturers: Dow Chemicals Dowfrost, Interstate Intercool, or equal inhibited mixture.

END OF SECTION 232113

SECTION 23 31 13

AIR DISTRIBUTION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this Section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Ductwork - Rigid, Flexible and Fabric
2. Diffusers, Grilles, and Registers
3. Ductwork Specialties
4. Flexible Connections
5. Sealants, Adhesives and Tapes
6. Duct Access Panels and Doors
7. Variable Air Volume (VAV) Terminal Units

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic Materials and Methods

B. Section 230593: Testing, Adjusting and Balancing

C. Section 230713: Duct Insulation

D. Division 26: Electrical

1.4 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:

1. ARI 885-98 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminal and Air Outlets
2. AMCA-210 - Laboratory Methods of Testing Fans for Rating Purposes
3. ANSI S12.23 - Designation of Sound Power Emitted by Machinery and Equipment
4. ASC-A7001 - Standard for Duct Sealants
5. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip. Type 304 or 304 stainless steel
6. ASTM A525 - Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) Hot-Dip Process. G60 and G90 zinc-coated
7. ASTM A527/A527M - Standard Specification for Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
8. UL 181 - Factory-Made Air Ducts and Connections, Class 1

9. ASHRAE Standard 130-2008 Methods of Testing Air Terminal Units
10. AHRI Standard 885-2008 - Procedures for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
11. NFPA 90A - Standards for the Installation of Air Conditioning and Ventilating Systems

B. Provide and construct ductwork systems in conformance with the latest editions of the following documents:

1. SMACNA - HVAC Duct Construction Standards-Metal and Flexible – 2005
2. SMACNA - HVAC Phenolic Duct Construction Standards - 2015.
3. SMACNA - Accepted Industry Practice for Industrial Duct Construction" for duct pressures above +5" W.G. positive pressure or below -5" W.G. negative pressure. Where differences exist between SMACNA and the prevailing building code, the gauge or construction method of the submitted ductwork shall be the more stringent of the two standards
4. ASHRAE Systems and Equipment Handbook "Duct Construction" chapter
5. ASHRAE Fundamentals Handbook "Duct Design" chapter

C. Alternatives: The SMACNA standards and publications referenced in this Section of the specifications establish ductwork construction requirements.

1. Alternatives to these standards and publications may be submitted. Approval will be based on demonstration that such alternatives are equivalent and satisfy the functional requirements described in the referenced standards.
2. Such demonstration shall include evidence that the alternatives proposed were tested in accordance with SMACNA procedures and with test results certified by an independent testing laboratory.

D. All ductwork and equipment shall be seismically supported and braced per the SMACNA “Seismic Restraint Manual: Guidelines for Mechanical Systems”.

E. Flame/Smoke Rating: All materials, including sealants and adhesives, exposed within plenum shall have a flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

1.5 SUBMITTALS

A. Prior to construction, submit for approval on all materials and equipment:

1. Ductwork - Rigid, Flexible and Fabric
2. Ductwork Specialties
3. Flexible Connections
4. Sealants, Adhesives and Tapes
5. Duct Access Panels and Doors
6. Diffusers, Grilles, and Registers
7. VAV Boxes
8. SMACNA "HVAC Duct Construction Standards - Metal and Flexible"

B. Shop Drawings: Provide shop drawings of sheet metal ductwork and plenums as follows:

1. Draw to a scale not less than 1/8" to one foot, with sheet sizes equal to Contract Drawings.

2. Show duct sizes, where possible use even duct sizes.
3. Show fitting details.
4. Show coordination with lighting fixtures, fire dampers, fire/smoke dampers, piping, diffusers, grilles, registers, fans, major electrical runs, cable trays and bus ducts.

C. Certifications: Provide a duct schedule, certified by an officer of the sheet metal fabrication subcontractor, that the ductwork conforms to SMACNA standards, and for each sheet metal system furnished on the project include:

1. System name.
2. Duct material.
3. Duct gauge.
4. SMACNA rectangular reinforcement number.
5. SMACNA intermediate reinforcement number.
6. SMACNA transverse reinforcement number.
7. Rod diameter and type.
8. Sealant type.
9. Attachment method.
10. Duct system design pressure.

D. Construction IAQ Management Plan: Collaborate with the general contractor to submit and implement an IAQ Management Plan for the construction process meeting the requirements of the SMACNA IAQ Guidelines. This plan should address the protection of the ventilation system components during construction and cleanup of contaminated components after construction is complete. SMACNA IAQ Guideline recommends control measures in five areas. The IAQ Management Plan should address how compliance has been achieved in these required five areas as follows:

1. HVAC Protection

    a. Shutdown of return side of existing HVAC system in areas affected by heavy construction.
    b. Provision of temporary filters if existing or new systems must remain operational during construction.
    c. Dampering of supply and returns and sealing of openings in areas subject to construction dust.

2. Source Control

    a. How will reduction of contaminants be reduced at the source?
    b. What steps will be taken to employ low emitting products and sealants.
    c. How will air handling equipment be cycled off when not needed?

3. Pathway Interruption

    a. Describe how the construction space will be ventilated as required to dilute contaminants.
    b. Describe how occupied spaces adjacent to construction areas will be kept at positive pressure relative to spaces under construction.

4. Housekeeping: Describe how the following housekeeping objectives will be implemented:

    a. Reduction of dust generated by work will be suppressed.
    b. Maintaining a frequent cleaning frequency for dust and particulates.
    c. Remove spills or excess applications of solvent-containing products as soon as possible.
    d. Remove accumulated water and keep work areas as dry as possible.
    e. Protect insulation materials from exposure to moisture.

5. Scheduling: Describe how overlap of construction activity and ongoing building occupancy activities will be minimized.

E. Field Manual: Submit one copy of the SMACNA "HVAC Duct Construction Standards - Metal and Flexible". Maintain a second copy on the project site.

F. Any ductwork installed without prior approval by the specifier, shall be replaced at the expense of the contractor.

G. The contractor must comply with the enclosed specification in its entirety. If on inspections, the specifier finds changes have been made without prior approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.

H. At the discretion of the specifier, sheet metal gauges, and reinforcing may be checked at various times to verify all duct construction is in compliance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged components. Remove damaged products from project site.

1.7 WARRANTY

A. Refer to Section 230500 for basic warranty requirements.

PART 2 - PRODUCTS

2.1 DUCTWORK

A. Construct all ducts and plenum of gauges, and with joints, bracing, reinforcing, and other construction details in accordance with the latest construction standards previously listed. Metals shall be manufactured by United States Steel, Kaiser, Rolok or equal.

B. Duct dimensions indicated on drawings are net, inside, clear dimensions. For internally lined ducts, add lining thickness to determine metal duct dimensions.

C. Ducts shall be constructed of material gauges and reinforcement per SMACNA pressurization classifications to meet 150% of the pressure requirements for external static pressure scheduled on drawings for the fans serving each system. Where differences exist between SMACNA and the prevailing building code, the gauge or construction method of the submitted ductwork shall

be the more stringent of the code or standard. Refer to Part III - Execution for matrix of pressure and leakage requirements.

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G60 (Z180) for ductwork inside the building envelope in non-corrosive environments. G90 (Z275) for ductwork installed external to the building and may be installed inside the building as an alternate to G60.

C. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

E. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black in concealed areas and white for ductwork in exposed spaces.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

2.3 DUCTWORK FABRICATION

A. Joints – Rectangular Ducts

1. Slip drive joints, standard seams, flanges or welding as required by SMACNA HVAC Duct Construction Standards for system static pressure. Ductmate, MEZ Industries, or equal are acceptable joint methods, but must be sealed as described previously. Transverse duct joints shall be constructed per Figure 1-4 for types T-8 through T-25. T-1 and T-5 slip joints are NOT allowed. Joint T-2, T-3, T-6 and T-7 reinforced slip joints are allowed below 2” static pressures.

B. Joints - Round

1. Exposed Ductwork: Slip drive and sheet metal screws.
2. Concealed Ductwork: Sheet metal screws.

C. Elbows

1. Construct long radius elbows with centerline not less than 1.5 times the duct width. Shorter radius elbows may be used where required to fit in restricted spaces, or as shown. Provide single thickness turning vanes on all short rectangular radius elbows less than 25" wide. Provide double thickness turning vanes for short rectangular radius elbows 25" wide and greater. Number of vanes per SMACNA. Elbows with square throat and radius heel are NOT allowed.

D. Transitions

1. Construct transitions to meet the meet, or be less than slopes identified per SMACNA HVAC Duct Construction Standards-Metal and Flexible. Slopes shall generally be no greater than 15%, and no greater than 30% where shown on the drawings.

E. Branch Connections

1. Provide 45°entry boots or radius taps for rectangular duct take-offs. Provide conical, bellmouth or 45° lo-loss boot taps for round duct take-offs. Straight 90° taps and spin-in taps are not allowed, except where round take-off duct size equals height of branch duct size. Provide volume dampers at each duct take-off for balancing. Provide insulation guards at transitions to lined ductwork.

2.4 RECTANGULAR DUCTWORK

A. Construct rectangular ductwork to meet all functional criteria defined in of the SMACNA HVAC Duct Construction Standards-Metal and Flexible. All ductwork must comply with all local, code requirements. Ductwork shall be constructed of galvanized steel. Diagonally cross break all panels on ducts 30 inches wide and larger, or bead using automatic bead machine with beads at 12 inches on center or less. All connections shall utilize 45° boot take-offs. Bullhead tees and straight taps are not permitted.

2.5 ROUND DUCTWORK

A. Round and oval ductwork shall be constructed to SMACNA round ductwork requirements of galvanized sheet steel. Comply with SMACNA HVAC Duct Construction Standards-Metal and Flexible, based on indicated static-pressure class unless otherwise indicated. Longitudinal seams shall be spiral lock seams or continuous welded. Flat oval may be utilized in space-restricted areas. Elbows shall be 5-piece mitered and welded. All elbows shall be long radius type with centerline radius to duct diameter of 1.5, exceptions will only be allowed at restricted space locations.

B. Round or oval duct and fitting manufacturers:

1. McGill Airflow Corporation
2. Lindab
3. Semco
4. Sheet Metal Connectors
5. Spiral Manufacturing

6. Or equal.

C. Transverse Joints: Fabricate according to SMACNA HVAC Duct Construction Standards-Metal and Flexible, for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions. All transverse joints to be externally sealed at all joints.

1. Exception: internal manufactured single or dual EPDM rubber gasket fittings do not require external sealant.
2. Transverse joints in ducts larger than 50” diameter require flanged joints.
3. Lap or snap lock seams are not permitted for round ductwork of any size.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA HVAC Duct Construction Standards-Metal and Flexible. All longitudinal joints shall be sealed air tight with sealant or continuous welding.

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-5, "45 Degree Tees and Laterals”, and Figure 3-6, "Conical Tees” and “45 Degree Boot Tees" for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions.

1. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted.

2.6 DIFFUSERS, GRILLES AND REGISTERS

A. All diffusers, grilles, and registers shall be selected to provide proper air distribution for the intended occupant application. All supply air devices shall be selected to provide a maximum air velocity of 50 fpm at three feet above the floor, unless otherwise noted. Manufacturer's representative shall carefully review Architectural and Mechanical drawings and ensure diffuser/grille/register selections will provide proper air distribution at NC 25 or less. Manufacturer at no additional expense to the Owner shall replace diffusers, grilles, and registers not providing proper distribution or excessive noise at scheduled airflow.

B. All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper where individual duct mounted balancing dampers are not provided.

C. Refer to schedule on drawings for sizes, capacities and patterns.

D. Manufacturers: Titus, Krueger, Price, Metal Aire, Nailor, Anemostat, Carnes, Tuttle&Bailey, or equal.

2.7 DUCTWORK SEALANT

A. Duct tape is not allowed.

B. Rolled elastomeric duct sealants are not allowed.

C. Solvent-based and oil-based sealants are not allowed indoors.

D. Seal all transverse joints, including mechanical joints similar to Ductmate, on all supply, return, exhaust, and outside air intake ducts.

E. All sealant systems for outdoor application to be suitable for use in exposure to water.

F. All sealant systems for indoor application to be meet VOC limits as specified in South Coast Air Quality Management District (SCAQMD) Rule #1168 limiting VOC's to 80 grams/Liter for duct liner adhesives and 250 grams/Liter for duct sealants.

G. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, suitable for high velocity and high pressure applications, UL 181B-M listed, UL 723 classified, and complying with NFPA requirements for Class 1 ducts.

1. Outdoor Application: Not permitted where subject to moisture exposure.
2. Indoor Application: Design Polymerics DP1010 or DP1020, Carlisle Hardcast Iron Grip 601, Ductmate PROseal, or equal.

H. Two-Part Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermally with tape to form hard, durable airtight seal. Carlisle Hardcast Two Part II, McGill Uni-Cast, or equal.

I. Rolled Mastic Sealant for indoor and outdoor application on flat sheet metal duct joints. Aluminum substrate with modified butyl sealant. Minimum thickness 17 mils. Service temperature of -20°F to 180°F (-28.8°C to 93.3°C). Seal Class A up to 19 inches w.g. VOC of 0 grams/Liter. Flame spread 20 (maximum) and smoke developed rating of 40 (maximum). Roll width as required to maintain minimum 3/4" adhesion width on each side of joint. City of Los Angeles RR#8069 approval. Manufacturer: Carlisle Hardcast #Foil-Grip 1402 or equal.

J. Manufacturers: Design Polymerics, Tremco, Dure Dyne, Carlisle Hardcast, Ductmate, Mon-Eco Industries, McGill AirSeal LLC, or equal, as recommended for ductwork application.

2.8 FLEXIBLE DUCTWORK

A. Flexible one-inch thick insulated round ductwork may be utilized for final connections to each air outlet and inlet, unless shown otherwise on the plans. Maximum length of flexible ductwork in low pressure branches shall not exceed five (5') feet.

B. See Part III Execution for installation requirements. All connections shall utilize welded conical tees, aluminum conical fitting, Flexmaster #CBD, or 45° boot take-offs by Flexmaster #STO. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted. Dampers regulators shall include end bearings as manufactured by DuraDyne, Ventlok or equal.

C. Flexible ductwork for low pressure systems with positive static pressure at or below 2" w.g. positive pressure suitable for both terminal unit connection and diffuser/grilles shall be a trilaminate of aluminized polyester, fiberglass insulation, and polyester, mechanically locked to galvanized steel helix without adhesives, exterior 1" fiberglass insulation and fire retardant polyester outer jacket. Flexmaster #Type 5B, Thermaflex Model M-KE or approved equal.

2.9 DUCT/VAV UNIT SOUND CONTROL WRAP

A. Where indicated on the drawings, VAV unit or duct shall be wrapped with minimum 2" thick glass or mineral fiber blanket, 1.5 lb/ft^3 minimum density and two layers of "mass-loaded" vinyl sheet. Each lead vinyl sheet shall weight 0.4-0.5 lb/ft^2 and shall be 0.025 - 0.040 inches thick. The lead vinyl shall be applied to the fiber base fabric with edges overlapped by at least 2 inches and sealed with duct tape. Complete system or lead/vinyl material shall provide a minimum STC-20 as measured in an independent accredited acoustical laboratory in accordance with ASTM E90 and/or E413.

B. The following are acceptable:

1. Gray Loaded Vinyl from Singer Partitions, Inc., Chicago, IL.
2. Soundfab from The Soundcoat Company, Inc., Santa Ana, CA.
3. EAR WB-5 from EAR Corporation, Indianapolis, IN or approved equal.

2.10 DUCTWORK SPECIALTIES

A. General: Where specifically called for, materials for use in fabricating ductwork specialties shall be identical to that used to fabricate ductwork. See drawings and Part 3, Execution for schedule.

B. Volume and Splitter Dampers: Galvanized sheet metal blade and frame with Ventfabrics Inc., Ventlok operating hardware. For accessible dampers, provide #641 self -locking dial regulators and #644 self-locking dial regulators for insulated ductwork, #637 square end bearing, and #635 spring end bearing, as applicable. For inaccessible dampers, provide #666 or #677 concealed locking damper regulator with bearings as above. For static pressures above 3" W.G., provide #640 HiVel dial regulator and #609 HiVel end bearing for accessible dampers. Regulators shall extend to and through ceiling with neatly installed hardware at the finished ceiling. For inaccessible dampers requiring adjustment through diffusers use Young Regulator, Bowden cable control system.

C. Flexible Connections: Provide flexible connectors at the discharge and inlet of fans, air handlers, rotating mechanical equipment, and where shown on the Drawings for proper vibration isolation. Neoprene impregnated glass cloth with 24-gauge galvanized metal frame. Neoprene-only connectors are not allowed. Minimum dimensions - 3" metal, 3" fabric, 3" metal. Ventfabrics #Ventglas or approved equal by Duro Dyne, Q Industries, consolidated Kinetics, Ductmate Proflex or Elgen.

2.11 DUCT ACCESS PANELS AND DOORS

A. In sheet metal work, hollow core double construction of same or heavier gauge material as duct in which installed. Use no door smaller than 12" by 12" for simple manual access or smaller than 24" by 24" where personnel must pass through infrequently. Use 24" by 60" minimum for filters and more frequent maintenance. Use Ventlok or approved hinges and latches on all doors; 100 Series hinges and latches on low pressure system doors up to 18 " maximum dimension, 200 Series on larger low pressure system doors and 333 Series on high pressure systems. Construct doors up to 18 " maximum dimension with one-inch overlap fit and gasket with 3/4" by 1/8" sponge rubber, fit larger doors against 1-1/2" by 1/8" flat stock or angle frame and gasket with 3/4" by 1/8" sponge rubber or felt. Door swing to be opposite airflow. CESCO, Pottorff, Vent Products, Air Balance, Ductmate Sandwich or equal. Access doors

smaller than 12" x 12" can be used for visual inspection of dampers, etc. on small ductwork less than 12" wide but must be of maximum size that will fit on duct with 6" x 6" as minimum size. All access doors smaller than 12" x 12" must be approved by the Owner's Representative for the specific application prior to ordering.

2.12 VARIABLE AIR VOLUME TERMINAL UNITS

A. Furnish and install variable volume zone boxes of the sizes and capacities shown on the Drawings.

B. The control assemblies shall be pressure independent and shall be able to be reset to any airflow between zero and maximum scheduled CFM. The valves shall be normally open. The differential static pressure of the basic assembly shall not exceed 0.25" W.G. for all sizes with inlet velocities of 2,000 FPM or less.

C. The air valve shall be galvanized steel or die cast aluminum; damper shafts shall operate in rustproof Delrin or equal, self-lubricating bearings. The air valve shall seat against durable gaskets and not exceed a 2% leakage rate per ARI standards.

D. The control device shall be designed to maintain consistent flow measurement regardless of inlet flow deflection. Angled duct inlets, at 90° or less to the control device, shall not alter the maximum or minimum factory setting by more than 10%. The assembly shall incorporate a multi-point averaging differential pressure sensor mounted on the inlet.

E. The assemblies shall be contained in a 26-gauge (minimum) galvanized steel box internally lined with either a minimum 1" thick fiber free insulation or a foil faced fiberglass insulation complying with NFPA 90A and UL 181 standards. Refer to Section 230700 "HVAC Insulation" for additional requirements. Fabricate and install 5 foot (minimum) acoustically lined sheet metal discharge plenum on all air terminal units. Discharge plenum shall be mounted downstream of reheat coils where applicable. Inside dimension of plenum shall be 2" larger in height and 4" larger in width than the outlet of the air terminal unit or reheat coil, whichever is greater. Refer to detail on plans for additional information. This is required for acoustic noise dissipation.

F. Hot Water Coil: Where scheduled on drawings, provide a single or double row hot water heating coil with aluminum fins mechanically bonded to copper coils. Coil velocity shall not exceed 700 FPM and static pressure loss shall not exceed 0.35" w.g. for a double row coil or 0.20"w.g. for a single row coil. Coil shall be pressure tested to 200 PSIG. Coil section to be based on 180°EWT and 140°LWT unless otherwise noted on schedule and include access door. Maximum water pressure drop shall be limited to 5 feet w.g. unless otherwise noted.

G. Electric Coil: Terminal manufacturer to factory install coil. Coil to be UL listed. They shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5" to prevent damage to elements during shipping. Elements shall be derated nickel chrome, supported by ceramic isolators a maximum of 3.5" apart, staggered for maximum thermal transfer and element life and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety device. Provide a primary automatic reset thermal cutout, a manual reset secondary thermal cutout, line fusing, mercury contactors per element, differential pressure airflow switch for proof of flow, and line terminal block. Coil shall be capable of operating under continuous duty at 120°F discharge temperature. Unit shall include an integral door interlock type disconnect switch which will not allow the access door to be opened while

power is on. Coils 4kw to 8kw shall be 2 stage, 8kw and larger shall be 3-stage. Coordinate final voltages with Div. 26.

H. Controls to be direct digital and connected to the BAS. Provide boxes without operator. Provide factory mounted low voltage transformer of sufficient capacity to power the DDC controls. Coordinate control with temperature Control Contractor. Provide factory mounted operator and thermostat control if not provided by Control Contractor.

I. Manufacturer: Titus ESV-3000, Price SDV, Trane VC, Enviro-Tec SSD, Carnes AV, Tuttle & Bailey SDV, Nailor 3000, or approved equal by Krueger, or Anemostat.

PART 3 - EXECUTION

3.1 DUCTWORK MATERIAL APPLICATION SCHEDULE

A. Fabricate ducts with galvanized sheet steel, except as otherwise indicated and as follows:

1. All duct system appurtenances are to be the same material as ductwork including volume dampers and access panels.
2. Environmental exhaust ductwork serving domestic clothes dryers shall be constructed of metal and shall have smooth interior surface. Provide backdraft damper at discharge to atmosphere.

3.2 DUCTWORK AND SPECIALTIES INSTALLATION

A. Ductwork is generally diagrammatically indicated and shall be generally installed as indicated. Do not scale Drawings for exact location of ducts. Install ducts to best suit field conditions and cooperate with other trades. Do not penetrate Structural members without consent of Architect or Structural Engineer. Check with Structural drawings prior to locating any penetrations. Duct sizes are indicated as net inside dimensions on the Drawings. The indicated dimensions shall be altered at the job site for the purpose of avoiding interferences and clearance difficulties to other dimensions producing the same air handling characteristics, provided such altered dimensions are approved by the Architect. Ducts shall be constructed in accordance with the latest edition of codes and standards identified in Part 1 and as shown on the Drawings.

1. Grilles, Registers and Diffusers: Install flush, squared, tightly sealed, and entirely covering sheet metal ductwork and gaskets. Thread sheet metal mounting screws tightly into sheet metal. All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper only where individual duct mounted balancing dampers are specifically noted as not provided. Duct connections shall fit securely to necks or collars behind face area. Provide all necessary transition pieces and duct collars to make connections from ductwork to neck sizes. Where ducts connect directly to necks or collars provide a minimum straight duct section of two times the duct diameter to the last elbow. Where minimum straight duct sections are not physically possible provide sheet metal plenum sized for approximately 500 fpm air velocity with duct tapped directly to side of plenum. Where building walls, floors and ceilings form portions of duct or plenum, provide gasketed angles or channels at junction points, securely bolted and sealed to building structure.

2. Install turning vanes in all mitered elbows in all ducts, so that tips are parallel with the sides of the ducts. Vanes shall be single thickness type. Tips of acoustical turning vanes on outside radius shall be flush with acoustical lining.
3. Provide flexible connections to completely isolate fans from direct contact with all sheet metal work.
4. Provide access panels or doors, as required, for access to valves, controllers, fire dampers and humidifier dispersion tubes.
5. Volume Dampers: Provide manual volume dampers in all supply, return and exhaust branch and run-out ductwork to grilles, diffusers, registers, and other inlet and outlet openings to facilitate balancing of air distribution systems. These are to be provided as part of contract whether shown on plans or not. Where ceilings are not accessible, provide access door or remote damper regulator. Volume dampers must be installed immediately downstream of each duct takeoff.
6. Splitters and splitter dampers shall not be installed in medium or low pressure supply ductwork to VAV systems.
7. Clean and pretreat surfaces before application of sealant. Conform to the manufacturer's cleaning procedures. Install sealants in conformance with manufacturer's instructions.
8. Except where noted, vertical ducts or horizontal ductwork penetrating fire rated ceilings, roofs, walls and floors shall be fire separated with UL listed and labeled fire dampers installed per UL tested assembly including sleeves and retaining angles. Provide additional fire dampers indicated on the Drawings and as otherwise required by the IBC and building inspector. Provide approved firestopping between damper frames and firewalls. Install fire dampers in accordance with NFPA Standards, requirements of the State Fire Marshal, and applicable codes. Ensure that fire dampers are installed in the open position.
9. For penetration of fire rated partitions which meet the IBC Chapter Seven requirements of non-Group H occupancy penetration of tenant separation and corridor walls in buildings with fire sprinklers provide metal sleeves as follows: A minimum 12 inch-long (0.30 m) by 0.060-inch-thick (1.52 mm) steel sleeve shall be centered in each duct opening. The sleeve shall be secured to both sides of the wall and all four sides of the sleeve with minimum 1-1/2" by 1-1/2” by 0.060-inch steel retaining angles. The retaining angles shall be secured to the sleeve and the wall with No. 10 screws. The annular space between the steel sleeve and wall opening shall be filled with rock wool batting on all sides.

B. Hangers and Supports: Securely fasten all ductwork to the building construction by means of hangers, supports, guides, anchors, and sway braces to maintain duct alignment, to prevent sagging, and to prevent noise and excessive strain on ductwork due to movement under operating conditions.

1. Maximum spacing between hangers shall not exceed ten (10) feet for rectangular sheet metal ductwork and twelve (12) feet for spiral round sheet metal ductwork. Provide hanger at each change in direction and at each branch takeoff. Refer to “SMACNA HVAC Duct Construction Standards Metal and Flexible” for requirements.
2. Adequately mount and anchor all material and equipment as required. Include lateral bracing as required to prevent horizontal, seismic movement. Refer to IBC and architectural Drawings for seismic requirements.
3. Do not support ductwork from fans or any other pieces of equipment.

4. Powder driver fasteners shall not be used to support rectangular ducts of 40" maximum dimension. Powder driven fasteners shall not be allowed in existing facilities where electronic equipment is located.
5. Support round duct, larger than 36", shall have two hangers at each support point.
6. Hangers and supports shall conform to SMACNA section "Hangers and Supports". Nail inserts, hangers and supports to formwork before slabs are poured. Cut off or remove nails, strap-ends and other projections, flush with concrete after forms are removed.
7. Support vertical ducts, passing through floors with two continuous angles screwed to the duct and bearing to the floor and conforming to SMACNA section "Riser Support-From Floor". Blocking or shimming ducts will not be permitted.

C. Other:

1. Insulation: Properly and neatly apply insulation on all material and equipment and apparatus, as specified, including all fittings. Apply insulation over clean, dry surfaces, with adjoining sections firmly butted together and canvas smoothly pasted over. When vapor barriers are specified, install continuous overall external surfaces of the entire system.
2. Duct Sizing: Where duct sizes are not specifically shown on the plans or must be modified due to physical limitations, supply ducts may be sized at a maximum velocity of 1,500 fpm or 0.08" sp friction per 100 feet, whichever provides the larger duct, and return/exhaust/intake ducts may be sized at a maximum velocity of 1,000 fpm or 0.06" sp friction per 100 feet, whichever provides the larger duct.

3.3 FLEXIBLE DUCTWORK INSTALLATION

A. Flexible insulated round ductwork may be utilized where shown on the Drawings and at the last five (5') feet to each air outlet and inlet, unless shown otherwise on the plans. Maximum of only one 90° bend in any length. Elbows in flex ductwork are to be supported using Flexmaster Flexright elbow support, or equal. No intermediate joints are allowed. Seal each end using 2 wraps of tape listed in accordance with UL 181B and marked 181B-FX, followed by a mechanical stainless steel screw operated drawband. Support duct to maintain smooth shape without sagging. All connections shall utilize welded conical tees, aluminum conical fitting, Flexmaster #CBD, or 45° boot take-offs by Flexmaster #STO. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted. Dampers regulators shall include end bearings as manufactured by DuraDyne, Ventlok or equal.

B. Flexible duct runouts to diffusers and grilles is limited to the following sizes:

1. 6" diameter: Up to 100 cfm
2. 8" diameter: Up to 200 cfm.
3. 10" diameter: Up to 360 cfm.
4. 12" diameter: Up to 600 cfm.
5. 14" diameter: Up to 900 cfm.

3.4 CONSTRUCTION AND SEALING CRITERIA

A. Leakage classification of ductwork conforms to requirements of SMACNA Air Duct Leakage Test Manual as follows:

SMACNA Leakage Classes Table 4-1			
Duct Class	1/2" to 2" W.G.	3" W.G.	4" to 10" W.G.
Seal Class	C	B	A
Sealing Application	Transverse Joints Only	Transverse Joints and Seams	Joints, Seams and All Wall Penetrations.
Leakage Class			
Rectangular Metal	24	12	6
Round Metal	12	6	3

B. Unless called out otherwise on drawings the pressure classification of ductwork shall be as follows:

Duct system:	**Location**	**Working Pressure**	**Build to SMACNA Pressure Class**	**Build to SMACNA Seal Class:**
Low press Supply Air	Downstream of air terminal units to grilles, registers or diffusers.	Low pressure	+1" wc	B
Transfer air	From grille to grille, or acoustic boots or "z" bends	Low pressure	+0.5" wc	C
Med press Supply Air	From AHU to air terminal units	+6" wc	+10" wc	A
Med press Supply Air	From AHU to air terminal units	+4" wc	+6" wc	A
Med press Supply Air	From AHU to air terminal units	+2" wc	+3" wc	A
Med. Press Return air	From air terminal units to AHU	-3" wc	-4" wc	A
Med. Press Return air	From air terminal units to AHU	-2" wc	-3" wc	B
Med. Press Return air	From air terminal units to AHU	-1" wc	-2" wc	B
Relief air	From AHU to discharge at ambient	+1" wc	+2" wc	B
General exhaust	From grille to exhaust fan	-1" wc	-2" wc	B
General	From exhaust fan to	+1" wc	+2" wc	B

Duct system:	Location	Working Pressure	Build to SMACNA Pressure Class	Build to SMACNA Seal Class:
exhaust	discharge at ambient			

C. The default leakage classification of ductwork is as follows:

Duct working press. class:	Low pressure less than +/-0.5"wc	+/-0.5" to +/-2.99"	+/-3" to +/-10" wc
SMACNA Seal Class	C	B	A
Sealing Applicable	Transverse joints only	Transverse and longitudinal Joints	Joints, seams, and all wall penetrations
Rectangular sheet metal SMACNA Leakage Class	24	12	6
Round sheet metal SMACNA Leakage Class	12	6	3

3.5 DUCT SEALING ALTERNATIVE

A. Occasionally a ducted system will experience leaks after the ductwork has been installed and sealed per one of the SMACNA duct sealant classifications. These leaks may not be identifiable until after ductwork has been installed and system air balancing and leakage testing has been engaged. At the contractor's option an alternative solution to sealing such leaks may include the use of a water based sealing agent that is introduced to the interior of the duct system.

1. Manufacturer: Aeroseal LLC or approved equal. Application must be performed by manufacturer approved provider.
2. Sealant must be UL 723 approved for smoke and flame spread.
3. Sealant must be UP 181 approved for humidity, mold growth, temperature, erosion and puncture resistance.

B. Duct Sealing Procedure:

1. Preparation:

a. Inspect the entire duct shaft and horizontal plenums for major leakage sites (larger than 1/2" across).
b. Mechanically clean duct shaft per NADCA standards if more than 1/8" of surface contaminants are visible on duct surfaces.
c. Repair all major leakage sites using mastic and fiberglass mesh tape per SMACNA standards.
d. Temporarily remove or protect all building controls and smoke detectors from aerosol particles as recommended by the Manufacturer.
e. Temporarily disable fire alarms and notify appropriate authorities.
f. Temporarily isolate air-moving equipment and block off air inlets and air outlets as recommended by the manufacturer.

g. Protect occupied spaces from aerosol particles as recommended by the Manufacturer.
h. Protect air-moving equipment, air inlets and outlets and other devices and appurtenances as recommended by the manufacturers.

2. Duct Sealing:

a. Seal existing ductwork from the inside using automated aerosolized sealant injection as recommended by manufacturer or by manually caulking internally with sealant.
b. Sealant must cure within 2 hours with no odor or VOC off-gasing thereafter.
c. Sealant shall remain elastic (not harden rigidly) after curing.
d. Sealant shall be deposited substantially at areas of leakage only, and shall not coat interior duct walls, duct lining material, dampers, or turning vanes.
e. Seal all test holes using patching plates sealed with mastic.
f. Repair or replace insulation to match existing.
g. Seal all injection openings with duct access doors or replace ductwork to match existing.

3. Duct Reassembly and Cleanup

a. Reinstall building controls and smoke detectors.
b. Enable fire alarms and notify appropriate authorities.
c. Remove blocking, reinstall grills and registers, and enable air handling fans.
d. Cleanup sealant residue that may have adhered to surfaces in occupied areas as recommended by the Manufacturer.
e. All work shall be done in a substantial and workmanlike manner by factory-trained technicians.

4. Testing

a. Provide pre-sealing and post-sealing leakage profile reports indicating percentage reduction of duct leakage for both supply and return ductwork.
b. Retest ductwork and document compliance with air leakage requirements as identified in section 230593 Testing, Adjusting and Balancing.

5. Warranty

a. The Contractor shall warrant that the aerosol sealant application will be free from defects for a period of 3 years from date of the sealing application. If defects should occur during this period, the Contractor shall repair or replace the defective duct seals, including the direct labor costs for performing the repair or replacement, at no additional cost to the Owner.

3.6 SEISMIC REQUIREMENTS

A. See Section 230549 for specific requirements.

B. All HVAC equipment and machinery shall be anchored to withstand forces generated by earthquake motions. As a minimum, equipment and equipment frames shall be designed to

withstand a force of 100% of the weight of the equipment and frame acting at its center of gravity. Anchorage of the equipment and/or frame to the structure shall be for a force of four times gravity also acting at the center of gravity.

C. The seismic calculations shall be the responsibility of contractor.

3.7 EQUIPMENT

A. Install equipment as shown on plans and in accordance with manufacturer's installation recommendations.

3.8 SUPPLY DIFFUSER AND REGISTER LOCATIONS

A. Coordinate location of supply outlets with ceiling mounted smoke detectors. Locate outlets or outlet distribution so as to prevent airflow from inhibiting the operation of smoke detectors. Locate ceiling outlets a minimum of 3'-0" from smoke detectors.

3.9 PAINTING

A. Where the interior surfaces of ductwork are visible through the blades of supply outlets, return inlets, and exhaust inlets - paint the interior visible surfaces with one coat of flat black paint.

B. Ductwork exposed on the roof or exterior to the building shall be painted. Coordinate with Division 9 for requirements.

3.10 FIELD QUALITY CONTROL

A. Do not insulate or conceal ductwork before inspection by Owner's Representative, Architect or Engineer. If ductwork is insulated and concealed prior this inspection the Contractor shall remove insulation and ceiling to permit inspection at no additional cost to the Owner. The Contractor shall replace the insulation and ceiling after final inspection at no additional cost to the Owner.

B. Ductwork Deflection Criteria:

1. Maximum inward and/or outward deflection at sheet metal panels shall be 3/4" under maximum static pressure operating conditions. Additional intermediate stiffening angles shall be installed where deflections exceed 3/4".
2. Maximum inward and/or outward deflection at sheet metal elbows and joints shall be 1/4" under maximum static pressure operating conditions. Additional stiffening angles shall be installed where deflections exceed 1/4".

C. Acceptance of duct systems shall be contingent upon conformance with the requirements specified in Section 230593 "Testing, Adjusting and Balancing".

3.11 ADJUSTING AND CLEANING

A. Clean the inside of plenums, casings, enclosures, fans, and accessible ductwork before starting fans. Blowout coils and condensate piping with compressed air. Comb all coil fins that may be bent. Install a clean set of filters in each system prior to testing and balancing. Proceed with testing and balancing. All dampers shall be locked in place.

END OF SECTION 233113

SECTION 26 05 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Basic electrical requirements for all Division 26 Sections.

1.2 RELATED WORK

A. General requirements specifically applicable to Division 26 in addition to the provisions of Division 1.

B. Work specified in other Divisions and Divison 26: (See Appendix A - Table of Contents)

1.3 QUALITY ASSURANCE

A. Provide equipment and materials which conform to the standards effective as of the date of the Contract Documents as promulgated by the following bodies:

1. Underwriters' Laboratories (UL).
2. National Electrical Manufacturers' Association (NEMA).
3. Electrical Testing Laboratories (ETL).
4. American National Standards Institute (ANSI).
5. Insulated Cable Engineers Association (ICEA).
6. California State Fire Marshal (CSFM).
7. California Electrical Code (CEC).
8. Titles 8, 19 and 24 of the California Code of Regulations (CCR).

1.4 SUBMITTALS

A. Submit electronic copies of manufacturer's submittal sheets or shop drawings for major items of electrical equipment and for any items specifically requested by the Electrical Engineer. When possible, make all electrical submittals at the same time.

1.5 INSTALLATION DRAWINGS

A. Prepare dimensionally accurate floor plans of each electrical and signal room and/or closet, fire control room and the like, drawn to 1/4" scale minimum. Submit electronic copies for review with two prints for Architect's record. Indicate all equipment within the rooms to scale based on shop drawing data, include structural support for suspended equipment and description of seismic bracing and fastening. Indicate system and equipment grounding details as applicable. Review elevator machine room shop drawings and coordinate location of electrical gear to maintain clearances. Submit with shop drawings.

B. Where conduit runs, 2" trade size and larger, are run in exposed locations, prepare dimensionally accurate floor plans indicating routing, coordinated with work of other trades and the structure. Submit legible reproducible transparencies with two prints for review.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain Record Documents which clearly indicate variances from the specified systems and which accurately locate all underground electrical conduits and structures.

1.7 EXAMINATION OF DOCUMENTS

A. Before submitting a bid, visit the Project Site and become familiar with conditions which may be pertinent to, or affect the cost of, the electrical installation.

B. Become acquainted with the Work of other installers whose activities will adjoin or be affected by the electrical Work. Consult with these other installers and study all pertinent Drawings in order to coordinate the Work and to avoid conflicts, omissions and delays.

1.8 PERMITS AND FEES

A. Obtain and pay for all necessary electrical permits and fees.

1.9 SUBSTITUTIONS

A. Refer to other Sections of these Specifications for substitution requirements.

1.10 DRAWINGS

A. For purposes of clarity and legibility, the electrical Drawings are essentially diagrammatic. although the size and location of electrical equipment is drawn to scale wherever possible, make use of all data in all of the Contract Documents, and verify this at the Project Site. Determine the exact location of conduits, outlets and equipment by the study of details, shop drawings and/or the Architect's directions.

B. The electrical Drawings show the required size and points of termination of the conduits and the quantity and size of the conductors within. However, the Drawings do not show all of the necessary conduit bends. Install conduits in such a manner as to conform to structure, avoid obstruction, preserve headroom and keep passageways and openings clear.

C. Locate outlets symmetrically with architectural elements, notwithstanding the fact that the locations shown of the electrical drawings may be distorted for clarity of representation.

D. The architectural Drawings take precedence over the electrical Drawings. Study the reflected ceiling plans and interior elevations to determine the exact location of lighitng fixtures, wall-mounted devices and fixtures, etc. The Architect has taken a very active role in the placement of these items. Should there be a conflict between locations shown on the architectural and electrical drawings, contact the Engineer for clarification prior to rough-in.

E. Before submitting a bid, examine all pertinent Contract Documents for electrical requirements which are not necessarily indicated on the electrical Drawings and include in the bid a sum which is sufficient to cover the costs of these other requirements.

F. Should it be perceived that the Contract Documents do not sufficiently define the required electrical work, contact the Architect for clarification or further description. Failure to do this will be construed as evidence of an understanding of the required electrical systems and their installation.

1.11 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 1).

1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

2. RFIs shall address single questions and related issues only.

3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to Owner’s Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
   a. Project number.
   b. Date.
   c. Name of Contractor.
   d. Name of Architect.
   e. RFI number, numbered sequentially and unique.
   f. RFI subject.
   g. Specification Section number and title and related paragraphs, as appropriate.
   h. Drawing number and detail references, as appropriate.
   i. Field dimensions and conditions, as appropriate.
   j. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   k. Contractor's signature.
   l. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

1) Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Incomplete RFIs or inaccurately prepared RFIs.

b. RFIs submitted without indication of review and approval for submission by General Contractor.

c. RFIs addressing multiple unrelated issues.

d. Requests for approval of submittals.

e. Requests for approval of substitutions.

f. Requests for approval of Contractor's means and methods.

g. Requests for information already indicated in the Contract Documents.

h. Requests for adjustments in the Contract Time or the Contract Sum.

i. Requests for interpretation of Engineer's actions on submittals.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.12 VERIFICATION OF AVAILABLE SPACE

A. Throughout the course of construction, verify that sufficient space will be available for the equipment to be installed.

1.13 IDENTIFICATION MARKINGS

A. Switchboards, distribution and branch panelboards, terminal cabinets and other miscellaneous electrical equipment shall be identified with laminated black and white engraved plastic nameplates which properly identify each item. Nameplates shall be attached with steel rivets or bolts and nuts.

1.14 EXISTING FACILITIES

A. Examine the drawings and specifications of the completed work and inspect the site to establish the scope of demolition work and new work to be provided under this sections and clarification of the phasing of the work.

B. Based on project phasing and scheduling, demolition work will be taking place in and around existing areas that are to remain in service. Where the work under this section affects or interferes with the operation of any existing areas to remain in service, or portions of the work

already in operation, provide all necessary work and material including premium pay, required to avoid shutdown of these areas during normal operations. Obtain Owner's approval for shutdown, in writing, 48 hours prior to shutdown.

C. Existing electrical and signal facilities outside of the demolition area to remain in place and in service during demolition.

D. Unless specifically noted or otherwise indicated or directed, remove all existing electrical equipment in the areas to be demolished. Deliver all equipment removed, including lighting fixtures, to the Owner's representative.

1.15 REMODELING

A. Where remodeling of existing areas is indicated, provide all work indicated and required for a complete and operating facility. Where work is adjacent to existing fixtures or devices, provide matching products to present uniform appearance. Salvage demolished material and equipment and deliver to Owner as directed. Dispose of salvaged materials and equipment where so directed in writing by Owner. Patch all openings in existing walls or floors caused by removal of materials and/or equipment under this work.

1.16 DEMOLITION

A. Where areas of existing facilities are indicated to be demolished or remodeled, visit site to determine scope of work. Relocate electric and signal system equipment, and reroute or replace conduit and wiring as required to conform with new use of the area and maintain operation of adjacent areas.

1.17 WATERPROOFING

A. Wherever electrical Work pierces waterproofing or waterproofing membranes, install it in an approved watertight manner.

1.18 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect electrical equipment and materials during transit, storage and handling to prevent damage, soiling and deterioration.

B. Provide new electrical materials and deliver them to the Project Site in unbroken packages.

1.19 CUTTING AND PATCHING

A. Provide core drilling, cutting and patching of existing construction and surfaces for the installation of electrical systems. Concrete, asphalt or plaster surfaces which have been damaged by such drilling or cutting shall be patched and repaired to match the surrounding surface.

1.20 ADJUST AND CLEAN

A. Keep the Project Site free from accumulations of electrical rubbish and debris. Remove such accumulations from the Project Site.

B. Thoroughly clean electrical equipment and materials of plaster, cement and other foreign materials and leave smooth, clean and dry.

1.21 FIELD QUALITY CONTROL

A. At project Completion or upon request of the Architect anytime, make necessary tests under the observation of the Architect which will ensure that electrical equipment, materials and installation methods are as specified.

B. At Project Completion, test electrical loads and controls under full operating conditions and immediately replace, at no cost to the Owner, defective electrical equipment, devices and workmanship. Make standard electrical equipment, materials and performance tests and also tests as may be required by the Architect, such as electrical insulation and ground resistance, or temperature rise.

C. Closing-in of Work: Do not allow Electrical Work to be covered or enclosed until it has been observed by the Architect's Representative. Should unobserved Electrical Work be covered or enclosed, uncover it for observation and then make repairs as necessary to restore the Electrical Work and the Work of other affected installers to its original and proper condition, at no cost to the Owner.

PART 2 - PRODUCTS

2.1 Not used.

PART 3 - EXECUTION

3.1 Not used.

END OF SECTION – BASIC ELECTICAL REQUIREMENTS

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

D. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC metal-clad cable and Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

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

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.

G. Class 1 Control Circuits: Type THHN-THWN, in raceway.

H. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

    a. Feeders to all panels

    b. Feeders to all motors over 1 HP

    c. Feeders and branch circuits to all Mechanical Equipment

    d. Feeders and branch circuits to all elevators.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG

and larger. Remove box and equipment covers so splices are accessible to portable scanner.

a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Grounding arrangements and connections for separately derived systems.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

   1. Instructions for periodic testing and inspection of grounding features at test wells and grounding connections for separately derived systems based on NETA MTS.

      a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Minimum length shall be 18 inches or as shown on drawings. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar. Provide exothermic where shown on drawings and where extending main service ground

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches minimum from wall, 18 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange.
2. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.4 LABELING

A. Provide labeling on all grounding conductors with in 12” of end of conductor.

3.5 FIELD QUALITY CONTROL

C. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps .

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 .
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Metal wireways and auxiliary gutters.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. ARC: Aluminum rigid conduit.

G. GRC: Galvanized rigid steel conduit.

H. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Republic Conduit.
7. Robroy Industries.
8. Southwire Company.
9. Thomas & Betts Corporation.
10. Western Tube and Conduit Corporation.
11. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel or aluminum.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

    a. Material: Steel
    b. Type: Setscrew or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

K. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 PVC-COATED STEEL CONDUIT

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

1. Kor Kap
2. Perma-Cote
3. Plasti Bond
4. Thomas & Betts

B. Description: PVC-coated rigid steel conduit.

1. ETL Verified and must bear the ETL PVC-001 label.
2. Hot dip galvanized inside and out.
3. Comply with NEMA RN 1.
4. PVC Coating Thickness: 0.040 inch, minimum.
5. Conduit must have a urethane coating on the interior of all conduit and fittings

    a. Urethane coating thickness: .002 inch, minimum.

C. Fittings for Conduit; listed for type and size raceway with which used, and for application and environment in which installed.

1. Condulets ½" through 2" diameter shall have tongue-in-groove gasket.
2. Condulets be supplied with plastic encapsulated stainless steel cover screws.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 as shown on drawings, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

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

a. Mono-Systems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

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

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a Pentair company.
7. Hubbell Incorporated; Killark Division.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell Company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable .
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

K. Gangable boxes are prohibited.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 as shown on drawings with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic .
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1, Type 3R, or Type 12 as shown on drawings, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC.
2. Concealed Conduit, Aboveground: GRC, IMC, or EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased where shown.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT .
2. Exposed, Not Subject to Severe Physical Damage: EMT Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:

a. Loading dock.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.

e. Electrical rooms.
f. Warehouse spaces

4. Concealed in Ceilings and Interior Walls and Partitions: EMT .
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel or nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch to devices with 3/4-inch minimum homerun. 1-inchminimum trade size for ENT underground outdoor use.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. A. Support conduit within 12 inches of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 24 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to California Building Code requirements. Install boxes with height measured to top of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Paint for identification.
7. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

4. Color for Neutral: White.
5. Color for Equipment Grounds: Green.
6. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, polyester flexible label with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

B. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.5 TAGS

A. Write-on Tags:
   1. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
   2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:
   1. Engraved legend.
   2. Thickness:

      a. For signs up to 20 sq. in., minimum 1/16 inch thick.
      b. For signs larger than 20 sq. in., 1/8 inch thick.
      c. Engraved legend with black letters on white face.
      d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
      e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

M. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

N. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

P. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

Q. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

R. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

S. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

J. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchgear.
    e. Switchboards.
    f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    g. Substations.
    h. Emergency system boxes and enclosures.
    i. Motor-control centers.
    j. Enclosed switches.
    k. Enclosed circuit breakers.
    l. Enclosed controllers.
    m. Variable-speed controllers.
    n. Push-button stations.
    o. Power-transfer equipment.
    p. Contactors.
    q. Remote-controlled switches, dimmer modules, and control devices.
    r. Battery-inverter units.
    s. Battery racks.
    t. Power-generating units.
    u. Monitoring and control equipment.
    v. UPS equipment.

END OF SECTION 260553

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Standalone daylight-harvesting switching and dimming controls.
   2. Indoor occupancy and vacancy sensors.
   3. Switchbox-mounted occupancy sensors.
   4. Emergency shunt relays.

B. Related Requirements:

   1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

   1. Show installation details for the following:

      a. Occupancy sensors.

   2. Interconnection diagrams showing field-installed wiring.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment will be attached.
3. Items penetrating finished ceiling, including the following:

    a. Luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Control modules.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Faulty operation of lighting control software.
    b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Wattstopper, DLM, nLight, Lutron Vive,

B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.
b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with power pack, to detect changes in indoor lighting levels that are perceived by the eye.

D. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

E. Power Pack: Digital controller capable of accepting 3 RJ45 inputs with two outputs rated for 20-A LED load at 120- and 277-V ac, for 13-A LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70.

1. With integral current monitoring

a. Compatible with digital addressable lighting interface.

1) Plenum rated.

2.2 INDOOR OCCUPANCYAND VACANCY SENSORS

A. Wattstopper DLM, nLight, Lutron Vive

B. General Requirements for Sensors:

1. Wall or Ceiling-mounted, solid-state indoor occupancy sensors.
2. Passive infrared, Ultrasonic and/or Dual technology.
3. Separate power pack.
4. Hardwired or Wireless connection to switch; and lighting control system.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:

    a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    b. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Sensor is powered from the power pack or Wireless.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Wall or Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of1000 square feet when mounted 48 inches above finished floor.

D. Ultrasonic Type: Wall or Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet when mounted84 inches above finished floor.

E. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet when mounted48 inches above finished floor.

2.3 EMERGENCY SHUNT RELAY

A. LVS, Wattstopper

B. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 277 V.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, combination receptacles with USB ports, and associated device plates.
2. Isolated-ground receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Communications outlets.
6. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

G. USB: Universal serial bus

1.4 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 5351 (single), CR5362 (duplex) 6362 (decora).
b. Hubbell; HBL5351 (single), HBL5352 (duplex) HBL2162 (decora).
c. Leviton; 5891 (single), 5352 (duplex) 16362 (decora).
d. Pass & Seymour; 5361 (single), 5362 (duplex) 26352 (decora).

B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; IG5362RN.
b. Hubbell; IG5362.
c. Leviton; 5362-IG.
d. Pass & Seymour; IG5362.

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.4 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type.

1. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
2. Include indicator light that shows when the GFCI has malfunctioned or tripped and no longer provides proper GFCI protection.
3. End of life function by rendering itself incapable of delivering power when the test fails or indicating visually/audibly that the device must be replaced.
4. Reverse line-load miswiring function by denying power to the receptacle face if it is miswired

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; VGF20.
b. Hubbell; GFR5352L.
c. Pass & Seymour; 2095 or 2096.
d. Leviton; 7590.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; CWL520R.
b. Hubbell; HBL2310.
c. Leviton; 2310.
d. Pass & Seymour; L520-R.

2.6 SNAP SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Single Pole:

1) Cooper; AH1221.
2) Hubbell; HBL1221.
3) Leviton; 1221-2.
4) Pass & Seymour; CSB20AC1.

b. Two Pole:

1) Cooper; AH1222.
2) Hubbell; HBL1222.
3) Leviton; 1222-2.
4) Pass & Seymour; CSB20AC2.

c. Three Way:

1) Cooper; AH1223.
2) Hubbell; HBL1223.
3) Leviton; 1223-2.
4) Pass & Seymour; CSB20AC3.

d. Four Way:

1) Cooper; AH1224.
2) Hubbell; HBL1224.
3) Leviton; 1224-2.
4) Pass & Seymour; CSB20AC4.

C. Pilot-Light Switches, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; AH1221PL for 120 and 277 V.
b. Hubbell; HBL1201PL for 120 and 277 V.
c. Leviton; 1221-LH1.
d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

2.7 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper;

b. Hubbell;.
c. Leviton;
d. Pass & Seymour;

B. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper;.
b. Hubbell;.
c. Pass & Seymour; .

2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

C. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper;
b. Hubbell;.
c. Leviton; .
d. Pass & Seymour;

D. Toggle Switches, Square Face, 120/277 V, 20 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper;
b. Hubbell;
c. Leviton;
d. Pass & Seymour;

2.9 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider ; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."

2.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic
3. Material for Unfinished Spaces: Galvanized steel .
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

2.11 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type , dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular , solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening

2.12 POKE-THROUGH ASSEMBLIES

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

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand.
3. Square D/Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold/Legrand.

C. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks complying with requirements in Division 27 Section "Communications Horizontal Cabling."
4. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 3-inchor 4-inch cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Division 27 Section "Communications Horizontal Cabling."

2.13 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing. Match existing as applicable.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up , and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.

2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following types of LED luminaires:
   1. Downlight.
   2. Recessed, linear.
   3. Strip light.
   4. Surface mount, linear.
   5. Suspended, linear.

B. Related Requirements:

   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

B. Ambient Temperature: 41 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

C. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. California Title 24 compliant.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:

   a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.

2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.

2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119